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TECHNICAL NOTE

U.S. DEPARTMENT OF THE INTERIOR – BUREAU OF LAND MANAGEMENT

An Economic Analysis Series For Screening Proposed Timber Management Projects

REPORT No. 1 Analytical Considerations

by

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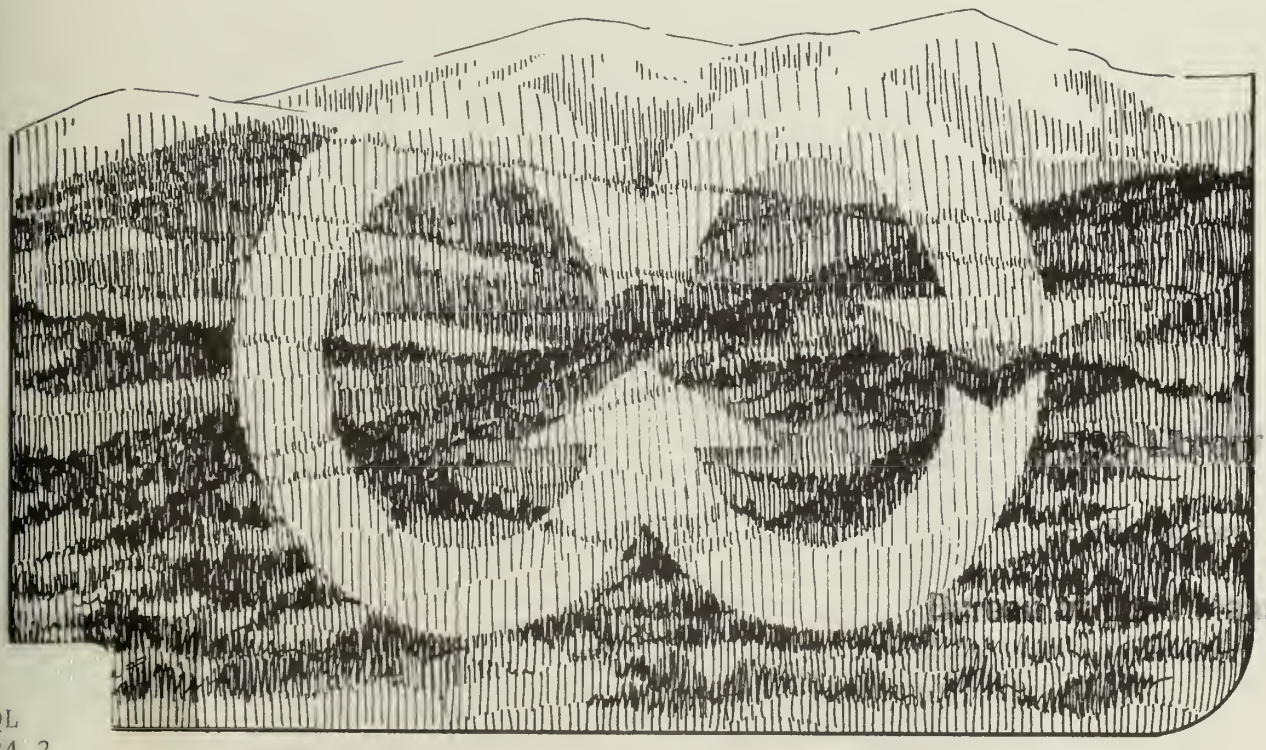

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FOREWORD

The purpose of this series of technical notes is to provide BLM personnel with a tool for screening proposed investments in selected intensive forest management practices. Report #1 expands upon the principles of economics as defined in BLM Manual 9521 and 9522, as applied to the principles of forest management. The allocation of changes in timber growth and yield, due to intensive management practices, is termed the allowable cut effect. The allowable cut effect (AEC) is used in the analysis of proposed investments in timber production along with secondary benefits and costs to other multiple use resources. Sound planning requires that we must identify and bring together both the negative and positive aspects of any proposed management action. The biological response must be weighed against other multiple use impacts.

Other reports of this series are involved with the inputs, outputs and mechanics of analyzing:

(1) precommercial thinning operations

(2) reforestation projects

(3) precommercial thinning followed by commercial thinning

(4) harvesting operations, and other types of proposed actions.

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I. Introduction

The primary objective of the timber management program is to produce a high level of raw material from forest lands classified as available for timber production, subject to the principles of (1) multiple-use, (2) sustained yield (even flow) (3) environmental quality, and (4) economic feasibility.

Timber management is not a short-term process; rather, it is a continuous use which involves different practices applied to different acres of the forest over various time spans. The magnitude and frequency of these applied practices depend upon the intensity of the program.

Most of the individual practices carried out on a particular area do imply a short-term use. However, the time frame used in this technical note in identifying the long-term impact is relatively long (extending up to 100 years) in order to equate the timber management cycle to the approximate rotational period of tree harvest. This is because trees are the predominant life form of the forest and the primary support to the productivity of the biotic community.

The achievement of forest management objectives and policies requires the forest management program to be representative of a coordinated, multi-resource plan that is based on technical, social, economic, and environmental criteria. As such, its formulation and implementation involve the utilization of expertise relating to the biological, social, and economic arts and sciences. Additionally, public input and review are solicited during initial planning and subsequent stages in order for the Bureau to be more effective in responding to the national interest.

A timber management program (activity and timber sale plan) for a given forest is the outgrowth of a process known as the Bureau Planning System, the purposes of which are to:

- Permit informed and objective multiple-use decisions through the identification and reconciliation of conflicting land and resource uses in advance of on-the-ground action.

- Help insure that land and resource use, development, and management plans and program decisions are responsive to Congressional, Departmental, and Bureau objectives.

The Bureau Planning System is designed to be used in the preparation and maintenance of land-use plans (multiple use) for Public Lands under BLM administration. These plans, called Management Framework Plans (MFP's) establish coordination between the seven basic resource values or activities for which The Public Lands are managed.

These activities include minerals, wildlife habitat, livestock forage, watershed, timber, recreation and intensive land use (e.g., rights-of-way, urban commercial, etc.), etc.

Management Framework Plans (MFP's) are prepared through a three-step process using (a) Resource Inventory Data, (2) Social and Economic Data, and (3) The Public Participation Process. During the first step, objectives and recommendations for each resource activity are prepared. These objectives become alternatives or options for later consideration. These alternatives must be acceptable, considering biological, social, institutional, economic, and policy points of interest. In addition, an integral part of the timber management program is the protection of all forests from insects, disease, wildfire, and other excessive adverse impacts upon their resources.

Timber management may also be considered as the management of millions of wood fiber factories spread over thousands of acres. These biological factories are of varying size, species, productive capability, and other differing attributes. They live together in an ever-changing forest environment and are subject to varying degrees of competition plus a host of external influences. Nature's supply of raw materials furnished to these factories is limited. The factories themselves are also limited in their capability to reach out and make use of raw materials such as sunlight (energy), moisture, soil nutrients, oxygen, carbon dioxide, trace elements, etc.

Through forest development practices or manipulation of timber stands, attributes such as species composition, number of stems per acre, average size, etc., foresters may increase the biological efficiency of the forest to produce a greater inventory of useable products in a shorter period of time than would be produced under wild, unmanaged forest conditions.

Individual practices are carried out on the ground, consistent with the approved timber management program, for the purpose of increasing the productivity of the timber resource and its availability for public use. They include protection, site preparation, seeding, planting, site and stand improvement, intermediate and final harvests, and the development of transportation systems.

Before evaluating the practices, it should be understood that many practices associated with timber production are not now being applied to all forest lands under the Bureau's administration, nor will they in the future because of technological, economic, or environmental constraints.

There may be a considerable difference between (1) the biotic efficiency to produce products desired by man and (2) the economic efficiency of a forest practice to make the best use of a capital investment at a given interest rate over a period of time.

Forest land managers are often faced with the task of allocating limited funds and manpower to a variety of possible competing investments. When the only constraint is the amount of funds available, project selection is straightforward, based upon Present Net Worth (PNW), Internal Rate of Return (IROR), or Benefit/Cost (B/C) ratio of the increase in timber production. When multiple use costs and benefits for forage, browse, water production, recreation values, insect resistance, and other factors are considered, in addition to direct timber values, the evaluation of a forest management package becomes more involved.

II. General Considerations

The purpose of this section is to provide guidelines and assistance to field personnel in the economic evaluation of proposed timber stand improvement projects and other silvicultural actions. BLM Manual Section 9521 (Benefit-Cost Analysis) should be reviewed before undertaking an evaluation of a program package.

The principal silvicultural actions applied to forest land and timber stands are:

- Reforestation of non-stocked productive forest land.
- Reforestation of forest lands which are presently vegetated with brush, inferior hardwood or conifer species.
- Precommercial thinning, weeding-cleaning-release, or stand improvement cuttings.
- Commercial thinnings of timber stands where the salable material is sold and removed; and
- Accelerated harvest of the oldest, most decadent, poorly stocked stands.

Other silvicultural actions which may be analyzed are listed below. These secondary actions are generally of a limited nature.

Forest fertilization

Terracing

Genetic Improvement

Cull tree removal

Pruning and Shaping

Snag Falling

Pest Control

Numerous research articles and opinions analyzing the Allowable Cut Effect (ACE) have been written. The allowable cut effect is the impact upon the entire forest management plan that is the result of an individual timber stand management decision. The primary benefits obtained are involved directly with timber production, and an immediate increase in the allowable cut as a direct response of a stand treatment.

The ACE works both ways, i.e., in increasing or decreasing the availability of harvestable timber. Just as an expected increase in future yields raises the allowable cut, an anticipated decrease in future yields on a portion of the forest acreage, due to insect attack, nonrecoverable blowdown, and similar catastrophies, can lower the allowable cut.

Multiple-use benefits and costs, other than increased timber yields, are identified in Section III. The Forester can provide the direct and indirect economic effect of a single treatment upon the timber resources as an independent variable. Benefits to other resources must be measured on a comparable scale. The total economic efficiency of a silvicultural treatment must be the summation of the timber and all other multiple use elements that are measurable in economic, or monetary terms.

During preparation of the approximately 150 allowable cut alternatives developed for the 17 public domain forest inventory units, it was impractical to make an individual economic analysis of every one of the numerous reforestation, growth, yield, stand improvement, etc., proposals fed into the simulation models. A detailed analysis is made of the final alternative selected.

The Bureau's IVST computer program can be used for evaluating forestry opportunities under three investment criteria: (1) Present Net Worth; (2) Benefit-Cost Ratio, and (3) Internal Rate of Return, under varying percentage rates of interest. Also, ADP printout data can be translated into graphic form for comparison purposes. The internal rate of return computations can be used for conducting a cost-effectiveness analysis. The objective of cost-effectiveness analysis is to determine the alternative which yields the greatest effectiveness for any given cost, or to show the alternative which yields a required degree of effectiveness for the least cost. Projects can then be ranked as necessary, and the optimum size of projects can be determined. Refer to BLM Manual Section 9522, Cost-Effectiveness Analysis, for the policies, procedures, and authority for conducting cost effective studies.

In determining costs and benefits, much of the data is reduced to a common denominator of one acre. Do not be misled by seemingly insignificant returns from one acre.

An increase of only 5 board feet per acre per year can represent a perpetual annual increment of a million board feet on a 200,000 acre forest. At $100.00 per MBF, this represents a perpetual annual income of $100,000. Irregardless of the magnitude of the program, the principle point is that the income stream or benefit flow is measured against a cost flow.

To make an economic evaluation it is necessary to compare the results obtained without the proposed project, to the results of the entire forest management operation with the proposed project in full production. The difference between the with-without concept in forest simulation modeling can develop into a chain reaction process, where both tangible and intangible results are listed along with primary and secondary benefits and losses occurring under each discipline. Refer to BLM Manual Section 9530, Techniques of Economic Analysis, for a more detailed description of the with-without concept.

Forestry representatives can compute the tangible timber production values in dollars and cents on a per-acre basis. In addition, narrative write-ups should be prepared which discuss the pros and cons of the intangible effects. Individual specialists in other multiple-use disciplines and economists must be utilized to determine the benefits and costs that timber management actions will have upon their functions. Multiple-use benefits and costs are discussed in Section III.

III. Multiple-Use Benefits and Costs

In computing the benefits obtained from adding or subtracting a timber management practice, it must be remembered that we are initially dealing strictly with constrained decisions. The policy of sustained-yield (even-flow), the technical restraints of the harvesting industry, fiscal appropriations, manpower limitations, biological responses, program restraints, and the overall economy, all have a constraining effect upon the management of forests. In addition, numerous multiple use conflicts are identified through examination of the unit resource inventory data. The Bureau's Planning System, Manual Sections 1601-1609, and specifically section 1608, Management Framework Plans, establish the procedures for making coordinated land-use allocations for a specific land area.

As identified in Section 103 of Public Law 94-579, October 21, 1976 (Federal Land Policy and Management Act of 1976) the definition of multiple use is:

"Section 103. Definitions

(c) The term "multiple use" means the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; the use of some land for less than all of the resources; a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and non-renewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific and historical values; and harmonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output".

Some of the points concerning multiple use benefits and conflict that should be examined are discussed briefly.

1. The forest management function generally must obtain access to forest lands. How should the administrative cost involved in obtaining legal access, which is used by all other functions, be distributed to these functions?

2. Adequate roads must be designed, constructed, and maintained. This cost in capital improvements is often built into the appraised timber price. Timber sale receipts are thus reduced by the value of these land improvements.

Roads into remote or inaccessible areas benefit fire control, livestock administration, recreationists, game management, minerals management, planning function, etc. How much would the stumpage be worth had other functions financed and maintained the road network? Is the road overbuilt for timber management purposes?

3. Road construction and logging may cause soil erosion and water degradation. What are the watershed values lost, disturbed, or degraded through the timber harvesting activity?

4. Dense, overstocked timber stands are essentially biological deserts for livestock, game and non-game animals. Precommercial and commercial thinning operations open up these dense stands which subsequently produce considerable grass, browse, and low cover. What is the value of the food and cover produced through the timber management activity?

5. Timber harvesting creates openings, edge effect, and browse and grass on areas formerly occupied by mature timber. These benefits slowly decline as the crowns of the new timber stand close in. What are the benefits to livestock, game, and non-game animals for this increased food and cover provided by the final harvest activity?

6. Increased timber harvesting and contract work involving stand improvement projects have a direct effect upon the local economy and a multiplier effect on the local and regional economy. Can a value be credited back to the individual action which began the movement? Be careful not to compare indirect or secondary benefits to direct costs in determing B/C ratio.

7. Insect and disease populations build up in overstocked, decadent timber stands. Insect and disease attacks are almost certain to occur in wild, unmanaged stands as nature attempts to relieve the overcrowded conditions. Thinning at the proper time reduces the incidence and susceptibility to these enemies. How much have past control activities cost us -- beetle control, budworm spraying, mistletoe sanitation, increased fire costs, etc. - in direct appropriations and personnel time? How much timber volume has been directly and indirectly lost through the activities of forest pests? What would we have saved through the control programs had proper management been initiated?

8. Increased water production generally results as a by-product of thinning. Light, frequent winter snows filter down through the crowns of thinned stands to build up the snowpack. The crowns of dense stands intercept these light snows where they sublimate the next day or two. In addition, less evapotranspiration takes place in open grown stands then in dense stands. The total amount of groundwater production in some instances has been estimated to be as much as 40 percent more from timber stands managed for water production than from unmanaged stands.

9. Intensive timber management generally involves a great deal of hard labor. What are the local socio-economic benefits obtained through putting local people to work upon the contract area? Would these people be placed on the unemployment rolls if the work were not provided?

10. Managed stands produce a clean, sound, uniform-sized product. This allows selection of machinery for maximum efficiency, mechanization of logging, and a higher quality, and more uniform product than is generally available from unmanaged stands. Since stumpage value is the residual left after logging, transportation, and manufacturing costs, how much more would a contractor bid for a clean managed stand than for a like amount of timber in a wild, unmanaged forest.

11. Bids for stumpage on the West Coast have approached a level of $200 per MBF (thousand board feet). In some of the Northern Rocky Mountain Districts stumpage prices have risen from $20 per MBF a few years ago to nearly $100 per MBF, recently. This wave in price rise is expected to flow eastward through the other Rocky Mountain States as raw material shortages develop. Can a realistic rise in value be projected for the increased yields anticipated under more intensive management? Be careful, however, to consider rising costs for the same time period. Unless these values and costs can be fully justified, it is probably best to stick with present data.

12. Before an investment of public funds is made on a forestry project, all appropriate planning procedure steps must be followed. Under Public Law 94-579, October 21, 1976, mining claimants have a three year period to file the required instruments in BLM offices. If not done previously, timber lands should be cleared under Public Law 167, July 23, 1955, (An Act to ammend the Act of July 31, 1947) (61 Stat. 681) and the mining laws to provide for multiple use of the surface on unpatented mining claims on the Public Lands.

13. The presence of non-market intangible benefits and costs should be recognized, even though their impact may not be included in a B/C analysis. The importance of some of these intangibles may become so great as to cause special efforts be undertaken to include them in a formal analytical process.

13a. Single use wilderness withdrawals are seldom rated in terms of their with-without economic potential. Direct users do not reimburse the Agency for the cost of their establishment or the administrative costs involved in their upkeep. The intangible value of thinking that one has saved one resource should not be included in a benefit/cost analysis.

13b. Livestock forage prices are largely the result of political compromise, although the present price is far closer to true competitive value than the receipts received, per animal unit month (AUM), just a few years ago.

13c. The value of goods and services provided to recreationists such as camp-grounds, trails, potable water, etc., are seldom considered when setting user fees for these services. Lost income, due to restrictions against timber harvesting, plus the growth potential lost annually due to recreational and scenic reserves is not listed on any of our financial statements.

13d. Regulated timber harvest generally improves habitat conditions for most wildlife species. Both game and non-game species may receive substantial benefits from timber harvesting. Wildlife populations may increase dramatically due to the creation of a more favorable habitat.

The increased population may then provide a direct threat to the remaining forest, specifically to seed crops and seedling size stands. Timber harvesting may be precluded entirely in some critical habitat areas, while in other areas timber harvest stipulations may allow cutting only during the winter months, thus providing fresh browse during critical periods.

IV. Screening Forest Investment Proposals

Subsequent reports contain step-by-step guidelines for processing an economic evaluation of a typical forest investment. Sample problems and a series of management assumptions are provided. Benefit/cost ratios and present net worth for the samples are presented in both tabular and graphic form. These canned examples may be used to screen District intensive forest management proposals.

Precommercial thinning (PCT) only is one of the most simple type of analysis, where a single PCT investment (cost) will return a terminable series of annual incomes, and which also require a terminable series of contractual costs.

Other proposals involving reforestation, precommercial thinning followed by several commercial thinnings, use of genetically improved stock, and site rehabilitation, etc., become rather involved when all are applied to the same acre.

The forester is able to fit his own local assumptions, inputs, and outputs, between two lines of the prepared graphs. *He should then be in a position to interpolate an approximate benefit-cost ratio of his local situation by plotting his data between the two prepared lines on one of the attached graphs or by double interpolation between two pages of the graphic presentation.

If the proposed local situation appears to have favorable benefit-cost ratio, as determined by the rough inspection method outlined above, then the exact input data can be fed into the DSC IVST computer program and an accurate printout analysis obtained for that proposed silvicultural action.

If the proposal only approaches a favorable B/C ratio as determined only from the increase in timber production, then the next step would be to examine the other multiple use benefits and costs. The sum of multiple use benefits, added to the values received from increased timber production, may be sufficient to justify the proposal for submission into the annual work plan programs.

If the proposed action shows a very poor benefit-cost ratio, the ideas should probably be abandoned as a favorable investment for public monies.

*Refer to tabular and graphic exhibits, pages 25 to 50.

V. Ranking Investment Proposals

Forest management is a unique type of publically owned business enterprise. The economics of Federal timber production and the values of products harvested are well known and accepted, because production and consumption have traditionally met at the market place under competitive public auction conditions. In areas where lumber manufacturing facilities are limited, and during times of low demand, Federal timber offered at the market-place may be in direct competition with offerings of private timber.

Prices of goods and services of some multiple use disciplines may be available; however, these prices seldom reflect their actual or true value. Many of the output or services provided by forests are not traded on the open market; their values have been arbitrarily set at one level or another, sometimes to justify a third purpose.

As demands for non-market products such as water production, recreational values, erosion losses, wildlife habitat, etc. continue to increase in a society with a decreasing supply of forest resources, they must be accounted for in determining the efficient allocation of resources.

Classic economic analysis requires that all inputs and outputs of a production process be measured with a common unit of value. The present net worth of the returns from the production of timber must be added to the present net worth of the value of all other multiple use disciplines. These individual input figures may be positive or negative depending upon the interest rate selected.

The final ranking of individual projects may be altogether different than the ranking of those same projects when considering only the timber production values. Priority ratings are generally applied to program packages submission included in the Annual Work Plan.

VI. Compound-Discount Interest Equations

The purpose of this section is to present the basic equation $(1+i)^n$ concerning a compounded single payment, and to show how it may be manipulated to develop multipliers for practically any condition involving long-term investments. Included are examples of compound-discount investments and payments over the length of time generally involved in forest management projects, For example, at a 6 percent interest rate, the present worth of $1,000.00 worth of stumpage that is harvested 80 years from now is only $9.45, (See Example #2: Discounted Single Payment, part d). Therefore, under strictly present net worth concepts and the interest rate shown, you cannot afford to invest more than $9.45 now, in order to get back an increased return of $1,000.00, 80 years from now. When the impact upon the allowable cut concept is followed (The Allowable Cut Effect), a considerably different conclusion may be reached.

There are a number of compound-discount interest rate tables available for use in financial analysis problems. In order to acquaint the reviewer with the action of long-term compound interest and discount rates, a listing of 10 examples has been prepared.

All of the data has been put into an identical format so that comparisons between the use of the various equations are more meaningful.

Both published tables and computer programs are available for use with actual field data. The Service Center Forestry Staff has the Investment Analysis Computer Program (IVST) operational and can process field data upon request.

The following computations use an annual rate of interest of 6 percent in terms of unit-interest-bearing-periods of 1 year increments. The examples are carried out for 1 year, 20 years, 50 years, and 80 years, since these periods represent the average lengths of time needed to husband pre-commercial and commercial forest management investments, such as reforestation, thinning, clearing, pruning, fertilization, etc.

EXAMPLE #

1. Compounded Single Payment $(1+i)^n$

   (6 percent interest rate compounded annually)

   If $1.00 is placed in an account now and no other deposits were made:

   a. At the end of 1 year the account would contain $1.06.

   b. At the end of 20 years the account would contain $3.21.

c. At the end of 50 years the account would contain $18.42.

d. At the end of 80 years the account would contain a total of $105.79.

2. Discounted Single Payment $\frac{1}{(1 + i)^n}$

(6 percent annual discount rate)

a. If $1.00 is to be placed in an account 1 year from now, the present value of that $1.00 is $0.9434.

b. If $1.00 is to be placed in an account 20 years from now, the present value of the $1.00 promised is $0.3118.

c. If $1.00 is to be placed in an account 50 years from now, the present value of this future payment is only $0.05429.

d. If $1.00 is to be received 80 years from now, the present value of this future payment is $0.00945, or less than one cent.

3. Compounded Periodic Payment $\frac{(1 + i)^n}{(1 + i)^n - 1}$

(6 percent compounded annually)

a. The present value of $1.00 received now and every year thereafter (forever) is $17.6666.

b. The present value of $1.00 received now and periodically every 20 years forever is $1.45308.

c. The present value of $1.00 received now and periodically every 50 years forever is $1.0574.

d. The present value of $1.00 received now and every 80 years forever is $1.00954.

4. Discounted Periodic Payment $\frac{1}{(1 + i)^n - 1}$

(6 percent discounted annually)

a. The present value of $1.00 to be received one year from now and then every year thereafter is $16.6666.

b. The present value of $1.00 to be received 20 years from now and then every 20 years thereafter is $0.45308.

c. The present value of $1.00 to be received 50 years from now and then every 50 years thereafter is $0.05740.

d. The present value of $1.00 to be received 80 years from now and then every 80 years thereafter is $0.00954.

5. Compounded Annual Payment $\frac{(1 + i)^n - 1}{i}$

(6 percent compounded annually)

a. The future value (one year from now) of $1.00 deposited annually (deposit made one year from now) for 1 year is $1.00.

b. The future value (20 years from now) of $1.00 deposited annually (start depositing one year from now) for 20 years is $36.78.

c. The future value (50 years from now) of $1.00 deposited annually (start depositing one year from now) for 50 years is $290.34.

d. The future value (80 years from now) of $1.00 deposited annually (start depositing one year from now) for 80 years is $1746.60.

6. Discounted Annual Payment $\frac{(1 + i)^n - 1}{i(1 + i)^n}$

(6 percent discounted annual payment)

a. The present value of a $1.00 payment deposited 1 year from now is $0.9434.

b. The present value of a series of $1.00 annual payments (start depositing 1 year from now) deposited for 20 years is $11.47.

c. The present value of a series of $1.00 annual payments (start depositing 1 year from now) deposited for 50 years is $15.76.

d. The present value of a series of $1.00 annual payments (start depositing 1 year from now) deposited for 80 years is $16.51.

7. Investment Increase $(1 + i)^n - 1$

(6 percent compounded annually)

a. The increase in value due to interest rate charges or investment earnings of $1.00 invested for 1 year is $0.06.

b. The increase in value due to interest rate charges or investment earnings of $1.00 invested for a 20-year period is $2.207.

c. The increase in value due to interest rate charges or investment earnings of $1.00 invested for a 50-year period is $17.42.

d. The increase in value due to interest rate charges or investment earnings of $1.00 invested for an 80-year period is $104.80.

8. Discounted Investment Increase $\frac{(1 + i)^n - 1}{(1 + i)^n}$

(6 percent discount annual rate)

Discounted value of interest earned on $1.00 invested for the length of time shown.

a. The present value of the increase in value of $1.00 invested for one year is $0.0566.

b. The present value of the increase in value of $1.00 invested for 20 years is $0.6882.

c. The present value of the increase in value of $1.00 invested for 50 years is $0.9457.

d. The present value of the increase in value of $1.00 invested for 80 years is $0.990.

9. Capital Recovery $\frac{i (1 + i)^n}{(1 + i)^n - 1}$

(6 percent compounded annually)

a. The annual payment which is needed to recover an original investment of $1.00 plus interest for 1 year is $1.060.

b. The annual payment which is needed to recover an original investment of $1.00 plus interest for a 20-year period is $0.08718.

c. The annual payment which is needed to recover an original investment of $1.00 plus interest for a 50-year period is $0.06344.

d. The annual payment which is needed to recover an original investment of $1.00 plus interest for an 80-year period is $0.06057.

10. Sinking Fund $\frac{i}{(1 + i)^n - 1}$

(6 percent compounded annually)

a. The annual payment needed (paid 1 year from now) which will accumulate with interest (at a compounded interest rate of 6 percent) to total $1.00 one year from now is $1.00.

b. The annual payment needed (start payments one year from now) which will accumulate with interest (at a compounded interest rate of 6 percent) to equal $1.00 at the end of a 20-year period is $0.02718.

c. The annual payment needed (start payments one year from now) which will accumulate with interest (at a compounded interest rate of 6 percent) to equal $1.00 at the end of a 50-year period is $0.00344.

d. The annual payment needed (start payments one year from now) which will accumulate with interest (at a compounded interest rate of 6 percent) to equal $1.00 at the end of an 80-year period is $0.00057, or 53-thousandths of one cent.

11. Conversion Periods

The computations in examples 1 through 10 above are based on annual payments and interest rates compounded or discounted for the entire year.

If the conversion period is for a length of time other than one year, the base interest rate and time period exponent must be converted to this period as follows:

Example: Law of Exponents $(1 + i)^n$ to $1 + \frac{i}{X})^{xn}$

Where: "n" represents an interest period of less than one year.
"X" represents the decimal or fractional portion of one year.
"x" represents the reciprocal of the fractional portion of one year.

Annual: Compound Interest figured at end of each year. Refer to Example #1, part b above.

$1.00 invested at 6 percent compound interest for 20 years equals $(\$1.00 + \frac{0.006}{1})(1)(20) = \underline{\$3.207135}$.

Semi-Annual: Compound Interest computed every 6 months (or 1/2 year) for a 20-year investment period equals
$(\$1.00 + \frac{0.06}{2})^{(2)(20)} = (\$1.03)^{40} = \underline{\$3.262038.}$

Quarterly: Compound Interest computed every 3 months or (1/4 year) for a 20-year investment period equals
$(\$1.00 + \frac{0.06}{4})^{(4)(20)} = \$1.015)^{(80)} = \underline{\$3.29066}.$

Monthly: Compound Interest computed monthly for a 20-year investment period equals
$(\$1.00 + \frac{0.06}{12})^{(12)(20)} = (\$1.005)^{(240)} = \underline{\$3.3102}.$

Daily: Compound Interest computed daily for a 20-year investment period equals
$(\$1.00 + \frac{0.06}{365})^{(365)(20)} = \$1.00016438356)^{(7300)} = \underline{\$3.31978}.$

Source: Refer to USDA Forest Service Research paper NC-51, 1971. Tables of Compound-Discount Interest Rate Multipliers for Evaluating Forestry Investments.

VII. PRECOMMERCIAL THINNING ONLY: LODGEPOLE PINE -- SITE INDEX 40

A. Present Situation

A forest contains a sizeable acreage of 10, 20, and 30-year old doghair stands of lodgepole pine seedlings and saplings. Site quality on these acreages vary from 30 to 60 based upon total height of dominant trees at age 50.

The Problem

Is it a good investment to precommercially thin these overstocked stands? (Regardless of whether or not future commercial thinnings are anticipated).

Let us set up some working guidelines and ground rules for solving a theoretical problem.

1. Situation and Assumption for the Entire Inventory Unit

   a. Sufficient mature and immature timber must exist in the unit to permit an immediate increase in the allowable cut, based upon the projected increased yield from the stand improvement project.

   b. Maturity or minimum harvest age in the simulated model is 90 years for lodgepole pine. For the idealized sample problems, use a projected age of 100 years as the average age when the stands will be harvested.

   c. All volume data in the examples are based upon the International (1/8" saw-kerf) Log Rule All trees larger than 6.0 inches (minimum) DBH to a fixed 5.0 inch diameter useable top are considered merchantable timber.

   d. Overstocked stands are precommercially thinned at age 20.

   e. The investment period for computing interest on invested funds is 80 years.

2. The Variables Encountered

A series of fixed and variable inputs used in an analysis of precommercial thinning of 20-year-old lodgepole pine stands (on site index 40 forest acreages) are listed below. These canned assumptions are fed into the IVST computer program and the results are shown with each of the examples.

a. Precommercial Thinning Costs.

The cost of precommercial thinnings vary from $25 to $100 per acre. In the sample computations use:

- $25.00 per acre
- $50.00 per acre
- $75.00 per acre
- $100.00 per acre

b. Timber Sale Administrative Costs.

The administrative costs for putting mature and overmature timber up for sale, i.e., planning, layout, cruising, contracting, etc., vary among District and State Offices. In the sample computations, use costs per thousand board feet as follows:

- $5.00 per MBF
- $10.00 per MBF
- $15.00 per MBF
- $20.00 Per MBF
- $25.00 Per MBF
- $30.00 Per MBF

c. Bid Prices for Timber

Bid prices for Public Lands timber sold vary from $5.00 per thousand board feet to nearly $100 per MBF during recent years. The bid prices may reflect sizeable investments in capital improvements such as access, roads, bridges, fencing, etc. In the sample problems following, bid prices used are:

- $5.00 per MBF
- $10.00 per MBF
- $20.00 per MBF
- $40.00 per MBF
- $80.00 per MBF

B. Yield Table Data -- Volume Comparisons.

Harvestable volumes from both managed and unmanaged stands are shown. Compare the volumes anticapted from a lodgepole pine stand, in an unthinned, stagnated condition, to the expected results from this same stand if it had been thinned to a 10x10 foot spacing at age 20.

Site Index 40
Lodgepole Pine (Pinus contorta Dougl.)

VOLUMES PER ACRE FOR STAND COMPARISON [1/]

Stand Age in years	Unthinned Stagnated Stand. Bd.Ft. Acre	Precommercial Thin at 20 years of Age: Thinned[2/] Stand Bd. Ft. Acre	Difference Due to Thinning Increased Volume: Bd. Ft. Acre	M.A.I. Acre
20		PCT.		
30		100	100	
40		2,100	2,100	
50		5,000	5,000	
60		8,100	8,100	
70	100	10,700	10,600	151
80	600	12,850	12,250	153
90	1,300	14,550	13,250	147
100	2,000	15,800[3/]	13,800	138
110	2,800	16,600	13,800	125
120	3,500	17,150	13,650	114
130	4,200	17,400	13,200	102

1/ Volumes are computed by the International 1/8" Log Rule: Utilization of all trees 6.0 inches DBH and larger to a fixed 5.0 inch top diameter.

2/ The yields shown represent a 10 percent reduction of the yield anticipated from an idealized stand prescription.

3/ At 100 years of age, stand atrributes are:

- Number of trees per acre = 410
- Acreage DBH = 8.5" inches
- Average height of growing stock = 52 feet tall
- Total basal area = 162 sq. ft. per acre
- Average form class = 0.80
- Average volume per tree = 43 board feet

C. IVST Input Computations

1. Increase in Allowable Cut

The increase in allowable cut is 172.5 board feet for each acre precommercially thinned at age 20. This increase in allowable cut may be harvested from mature or overmature timber anywhere within the unit:

Lodgepole Pine. Site Index 40 only.

- Increased Volume = 13,800 bd. ft. for each acre thinned
- Investment Period = 80 years between thinning and final harvest
- Annual Cut Increase = 172.5 bd. ft. per year for an 80-year terminable series, (divide 13,800 by 80 years).

2. Increase in Acreage Harvested

For every acre that is precommercially thinned, according to the above assumptions, the Forester can harvest 0.01725 acres of mature or overmature timber somewhere else in the inventory unit each year. The 0.01725 acreage figure is developed accordingly:

- Average Volume on mature timber stands in the inventory unit = 10,000 bd. ft. per acre.
- $\frac{172.5 \text{ Board Ft} = \text{Annual Cut Increase}}{10{,}000 = \text{Average Volume Acre}} = 0.0172$ acres to be harvested annually for the next 80 years.

3. Reforestation of Acreage Harvested

Reforestation costs will occur annually for the next 80 years on the 0.01725 acres harvested for every acre that is precommercially thinned. Reforestation costs vary from $25.00 to $100.00 per acre, based upon the methodology and success achieved.

For each acre precommercially thinned

Reforestation Costs Per Acre		Acres Harvested		Annual Cost
$ 25.00	X	0.01725	=	$0.43
$ 50.00	X	"	=	0.86
$ 75.00	X	"	=	1.29
$100.00	X	"	=	1.72

4. Annual Cost of Selling Timber

Administrative costs for selling the additional 172.5 board Feet of timber (increase in allowable cut) will occur annually for the next 80 years. The average cost for putting timber up for sale and administration of the sale varies from $5.00 per MBF to $25.00 per MBF.

For each acre precommercially thinned

Timber Sale Costs Per MBF		Increase Allowable Cut	Annual Cost
$ 5.00	X	172 bd. ft.	$0.86
$10.00	X	" " "	$1.72
$15.00	X	" " "	$2.59
$20.00	X	" " "	$3.45
$25.00	X		$4.31

5. Annual Income From Timber Sales

Sale of the additional 172-1/2 bd. ft. of old growth for each acre precommercially thinned will result in an annual income for the next 80 years. This income varies considerably among districts because of timber grade, logging costs, distance to markets, industry competition, etc.

For each acre precommercially thinned

Sale Price Per MBF		Volume Sold Bd. Ft.		Annual Income
$ 5.00	X	172.5	=	$ 0.86
$10.00	X	"	=	$ 1.72
$15.00	X	"	=	$ 2.59
$20.00	X	"	=	$ 3.45
$40.00	X	"	=	$ 6.90
$80.00	X	"	=	$13.80

VIII. Investments Analysis Outputs

A. IVST Printouts

The attached exhibits show:

- Annual costs and annual returns for each year of the investment period.

- Present net work of the series of benefits and of the costs involved at various rates of interest.

- Benefit/cost ratios of the present net worth at rates of interest shown.

- Internal Rate of Return (IROR) (when net worth wquals zero).

1. PCT: Lodgepole Pine: Site Index 40

- Series #A-1: 25-5-(Income)
  PCT costs = $ 25.00/acre
  Selling costs = $ 5.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #A-2: 25-10-(Income)
  PCT costs = $ 25.00/acre
  Selling costs = $ 10.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #A-3: 25-15-(Income)
  PCT costs = $ 25.00/acre
  Selling costs = $ 15.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #B-1: 50-5-(Income)
  PCT costs = $ 50.00/acre
  Selling costs = $ 5.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #B-2: 50-10-(Income)
  PCT costs = $ 50.00/acre
  Selling costs = $ 10.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #B-3: 50-15-(Income)
  PCT costs = $ 50.00/acre
  Selling costs = $ 15.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #C-1: 75-5-(Income)
  PCT costs = $ 75.00/acre
  Selling costs = $ 5.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #C-2: 75-10-(Income)
  PCT costs = $ 75.00/acre
  Selling costs = $ 10.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #C-3: 75-15-(Income)
  PCT costs = $ 75.00/acre
  Selling costs = $ 15.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #D-1: 100-5-(Income)
  PCT costs = $100.00/acre
  Selling costs = $ 5.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #D-2: 100-10-(Income)
  PCT costs = $100.00/acre
  Selling costs = $ 10.00/MBF
  Income = $ 5.00 to $80.00/MBF

- Series #D-3: 100-15-(Income)
  PCT costs = $100.00/acre
  Selling costs = $ 10.00/MBF
  Income = $ 5.00 to $80.00/MBF

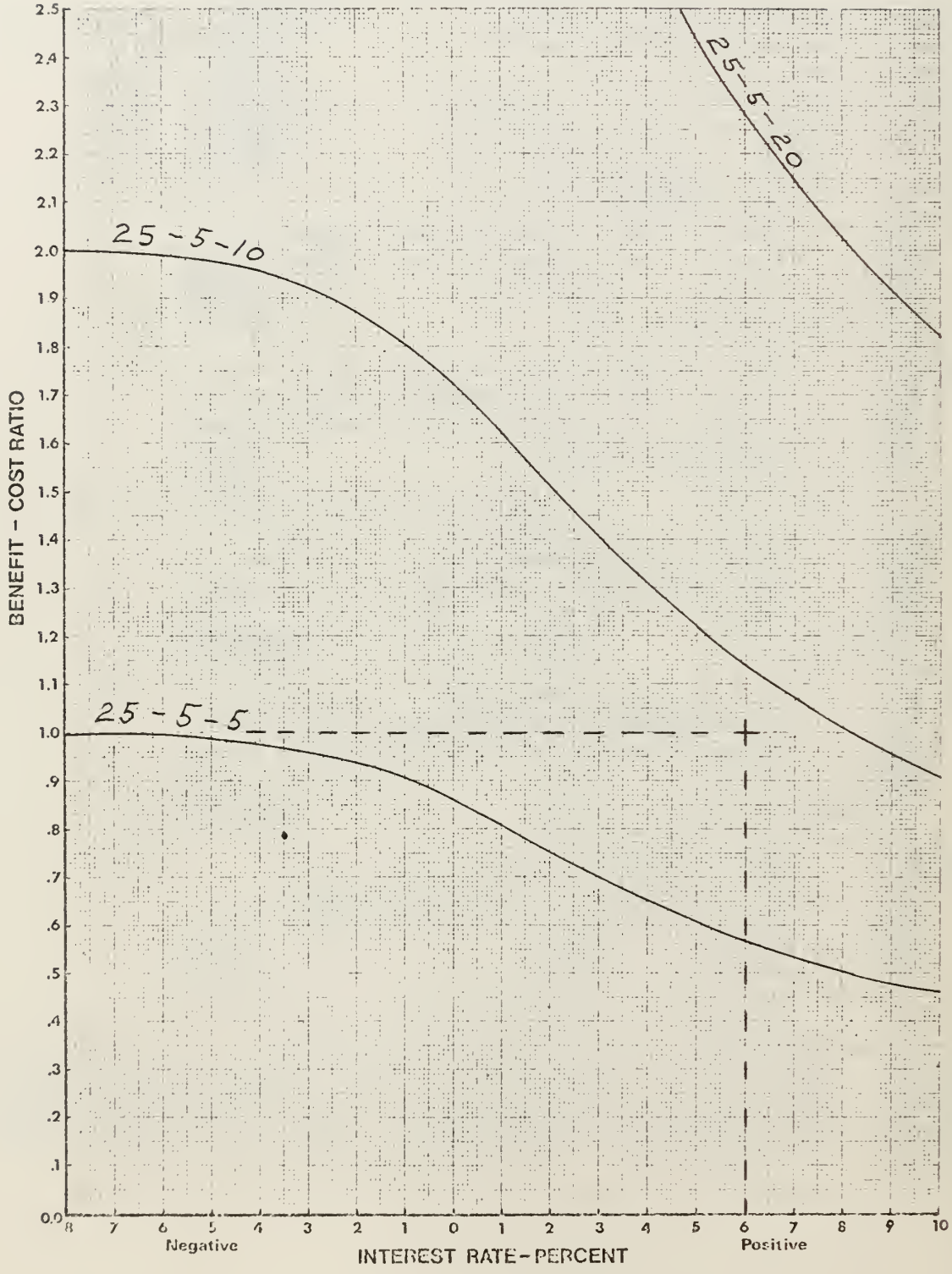
Present Net Worth
Benefit/Cost Ratio
25- 5-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $25	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.38
Present net worth		@ 6%	=	-$25.00
Code $25	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.75
Present net worth		@ 6%	=	-$9.95
Code $25	Cost of PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.51
Present net worth		@ 6%	=	$20.32
Code $25	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	3.01
Present net worth		@ 6%	=	$80.70
Code $25	Cost of PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	6.03
Present net worth		@ 6%	=	$201.45

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
25- 5-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age

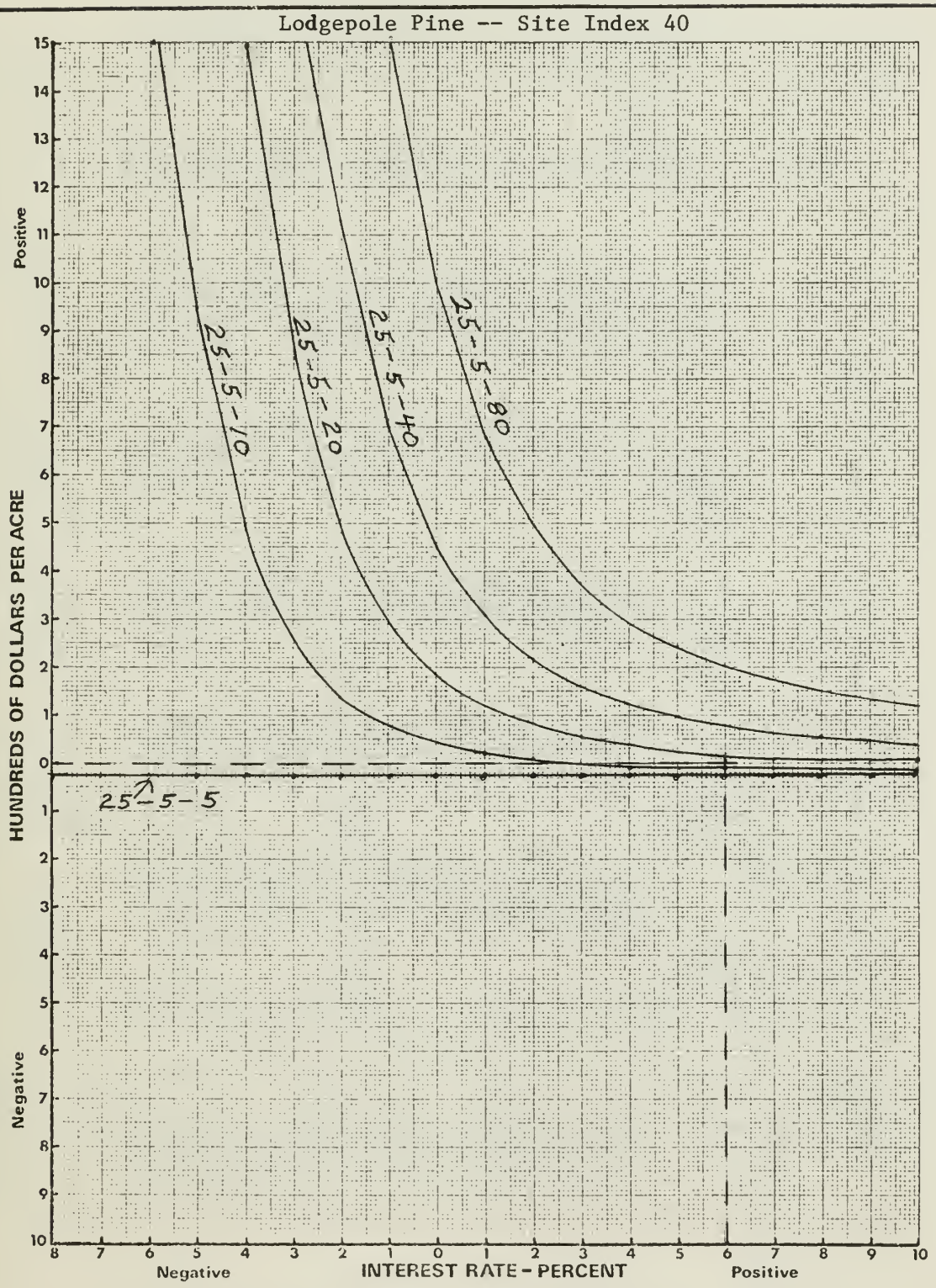


PRESENT NET WORTH

Alternatives

Precommercial Thin Only -- @ 20 Years of Age

25-5-5(5-10-20-40-80)



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS-COSTS & RETURNS PROBLEM # 1

PROBLEM NO. 1 LODGEPOLE PINE-SITE INDEX 40 F.H. @ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	25 05 05		25 05 10		25 05 20		25 05 40		25 05 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
10.00	-25.00	1.00	35394.74	2.00	106646.06	4.01	248736.86	8.02	532918.46	16.04
9.00	-25.00	1.00	16409.49	2.00	49469.57	4.01	115398.62	8.01	247256.74	16.02
8.00	-25.00	1.00	7755.47	1.99	23440.00	4.00	54696.46	8.00	117209.39	16.00
7.00	-25.00	0.99	3758.89	1.99	11370.66	3.99	26550.20	7.97	56909.29	15.94
6.00	-25.00	0.99	1863.69	1.97	5663.02	3.96	13239.72	7.92	28393.13	15.84
5.00	-25.00	0.97	948.04	1.95	2905.44	3.91	6808.92	7.82	14615.87	15.64
4.00	-25.00	0.95	495.13	1.91	1541.43	3.83	3627.99	7.66	7801.11	15.31
3.00	-25.00	0.92	265.18	1.84	848.92	3.69	2013.01	7.39	4341.21	14.77
2.00	-25.00	0.87	144.99	1.74	486.96	3.50	1168.91	6.99	2532.80	13.99
1.00	-25.00	0.81	80.11	1.62	291.54	3.24	713.19	6.48	1556.50	12.96
0.00	-25.00	0.73	43.80	1.47	182.20	2.94	458.20	5.88	1010.20	11.77
1.00	-25.00	0.66	22.68	1.31	118.58	2.63	309.84	5.26	692.36	10.53
2.00	-25.00	0.58	9.86	1.16	80.00	2.34	219.86	4.67	499.58	9.35
3.00	-25.00	0.52	1.75	1.03	55.57	2.07	162.88	4.15	377.52	8.29
4.00	-25.00	0.46	-3.61	0.92	39.42	1.85	125.23	3.70	296.84	7.40
5.00	-25.00	0.41	-7.30	0.83	28.29	1.66	99.28	3.33	241.26	6.65
6.00	-25.00	0.38	-9.95	0.75	20.32	1.51	80.70	3.01	201.45	6.03
7.00	-25.00	0.34	-11.91	0.69	14.41	1.38	66.91	2.76	171.92	5.51
8.00	-25.00	0.32	-13.41	0.63	9.89	1.27	56.37	2.54	149.32	5.08
9.00	-25.00	0.29	-14.60	0.59	6.34	1.18	48.08	2.36	131.56	4.72
10.00	-25.00	0.27	-15.54	0.55	3.48	1.10	41.41	2.20	117.27	4.40
11.00	-25.00	0.26	-16.32	0.52	1.13	1.03	35.93	2.07	105.55	4.13
12.00	-25.00	0.24	-16.97	0.49	-0.83	0.97	31.37	1.95	95.76	3.90
13.00	-25.00	0.23	-17.53	0.46	-2.49	0.92	27.50	1.85	87.47	3.69
14.00	-25.00	0.22	-18.00	0.44	-3.91	0.88	24.18	1.76	80.37	3.51
15.00	-25.00	0.21	-18.41	0.42	-5.14	0.84	21.31	1.67	74.21	3.35

A-2

Present Net Worth
Benefit/Cost Ratio
25-10-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $25	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.27
Present net worth		@ 6%	=	-$40.05

Code $25	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.55
Present net worth		@ 6%	=	-$25.00

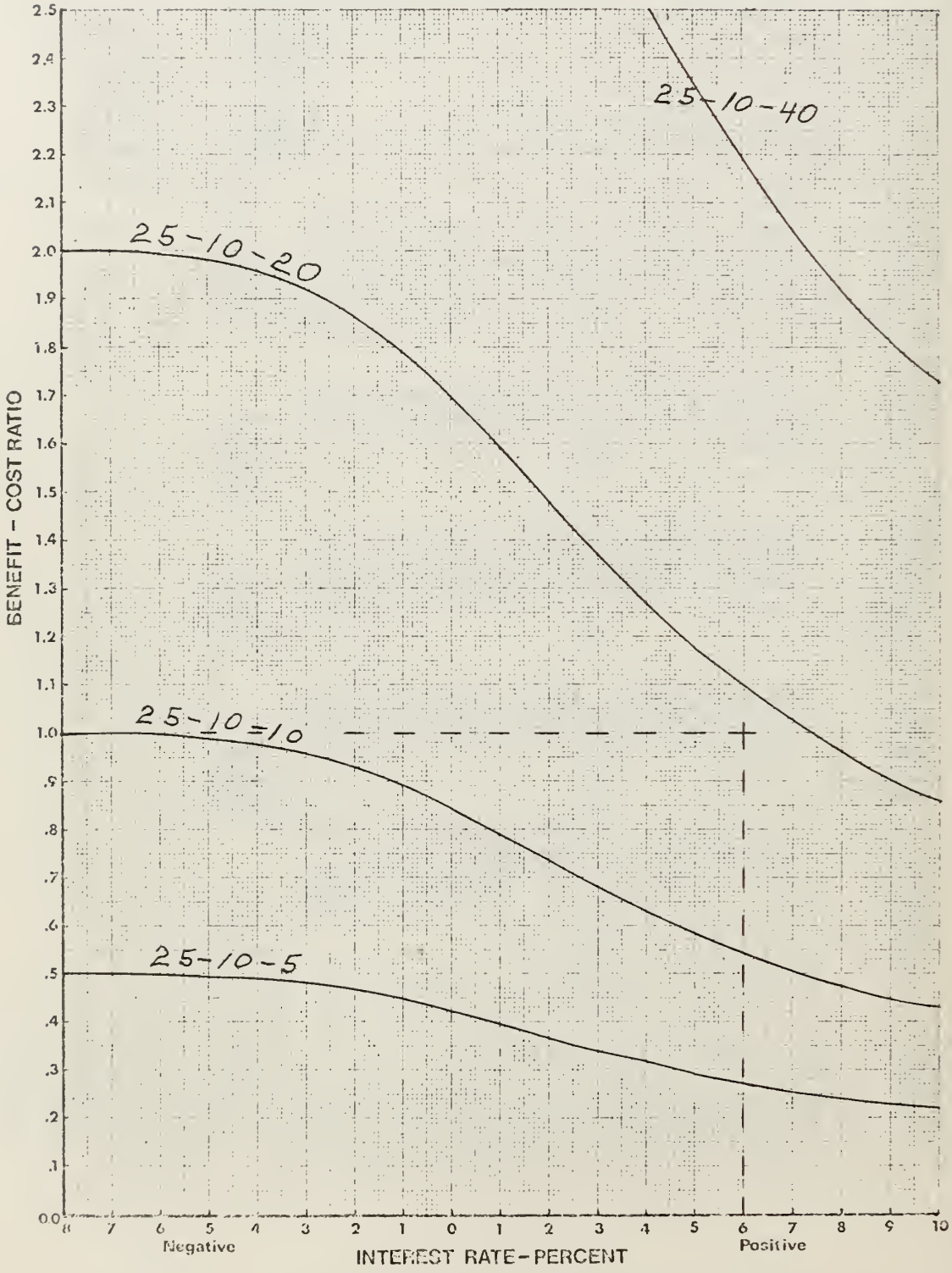
Code $25	Cost of PCT one acre			
$10	Cost to sell one MBF of mature timber			
$20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.10
Present net worth		@ 6%	=	$5.27

Code $25	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	2.19
Present net worth		@ 6%	=	$65.65

Code $25	Cost of PCT one acre			
$10	Cost to sell one MBF of mature timber			
$80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	4.38
Present net worth		@ 6%	=	$186.40

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
25-10-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS-COSTS & RETURNS PROBLEM # 1

PROBLEM NO. 1 LODGEPOLE PINE-SITE INDEX 40 F.H. @ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	25 10 05		25 10 10		25 10 20		25 10 40		25 10 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
10.00	-35444.74	0.50	-25.00	1.00	71226.33	2.01	213317.13	4.01	497498.73	8.02
9.00	-16459.49	0.50	-25.00	1.00	33035.08	2.00	98964.14	4.01	230822.25	8.02
8.00	-7815.47	0.50	-25.00	1.00	15648.53	2.00	46904.99	4.01	109417.92	8.01
7.00	-3805.89	0.50	-25.00	1.00	7586.77	2.00	22766.31	4.00	53125.40	8.00
6.00	-1913.69	0.50	-25.00	0.99	3774.33	1.99	11351.04	3.99	26504.44	7.97
5.00	-995.04	0.49	-25.00	0.99	1932.40	1.98	5835.88	3.96	13642.83	7.92
4.00	-545.13	0.49	-25.00	0.98	1021.30	1.96	3107.86	3.92	7280.99	7.83
3.00	-315.18	0.48	-25.00	0.96	558.74	1.92	1722.83	3.85	4051.03	7.69
2.00	-194.99	0.47	-25.00	0.93	316.96	1.87	998.91	3.74	2362.81	7.47
1.00	-130.11	0.45	-25.00	0.89	186.44	1.79	608.09	3.59	1451.39	7.17
0.00	-93.80	0.42	-25.00	0.85	113.40	1.70	389.40	3.39	941.40	6.79
1.00	-72.68	0.40	-25.00	0.79	70.91	1.59	262.16	3.18	644.68	6.36
2.00	-59.86	0.37	-25.00	0.74	45.13	1.48	184.99	2.95	464.72	5.91
3.00	-51.75	0.34	-25.00	0.68	28.81	1.37	136.13	2.73	350.77	5.47
4.00	-46.39	0.32	-25.00	0.63	18.03	1.27	103.84	2.53	275.45	5.06
5.00	-42.70	0.29	-25.00	0.59	10.60	1.18	81.59	2.35	223.56	4.70
6.00	-40.05	0.27	-25.00	0.55	5.27	1.10	65.65	2.19	186.40	4.38
7.00	-38.09	0.26	-25.00	0.51	1.33	1.03	53.83	2.05	158.83	4.10
8.00	-36.59	0.24	-25.00	0.48	-1.69	0.96	44.78	1.93	137.73	3.86
9.00	-35.40	0.23	-25.00	0.45	-4.07	0.91	37.67	1.82	121.15	3.64
10.00	-34.46	0.22	-25.00	0.43	-5.99	0.86	31.95	1.73	107.82	3.46
11.00	-33.65	0.20	-25.00	0.41	-7.55	0.82	27.26	1.64	96.87	3.29
12.00	-33.03	0.20	-25.00	0.39	-8.85	0.78	23.34	1.57	87.73	3.14
13.00	-32.47	0.19	-25.00	0.37	-9.96	0.75	20.02	1.50	80.00	3.00
14.00	-32.00	0.18	-25.00	0.36	-10.91	0.72	17.18	1.44	73.36	2.88
15.00	-31.59	0.17	-25.00	0.35	-11.74	0.69	14.71	1.39	67.61	2.77

A-3

Present Net Worth
Benefit/Cost Ratio
25-15-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $25	Cost to PCT one acre			
$15	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.21
Present net worth		@ 6%	=	-$55.27

Code $25	Cost to PCT one acre			
$15	Cost to sell one MBF of mature timber			
$10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.43
Present net worth		@ 6%	=	-$40.22

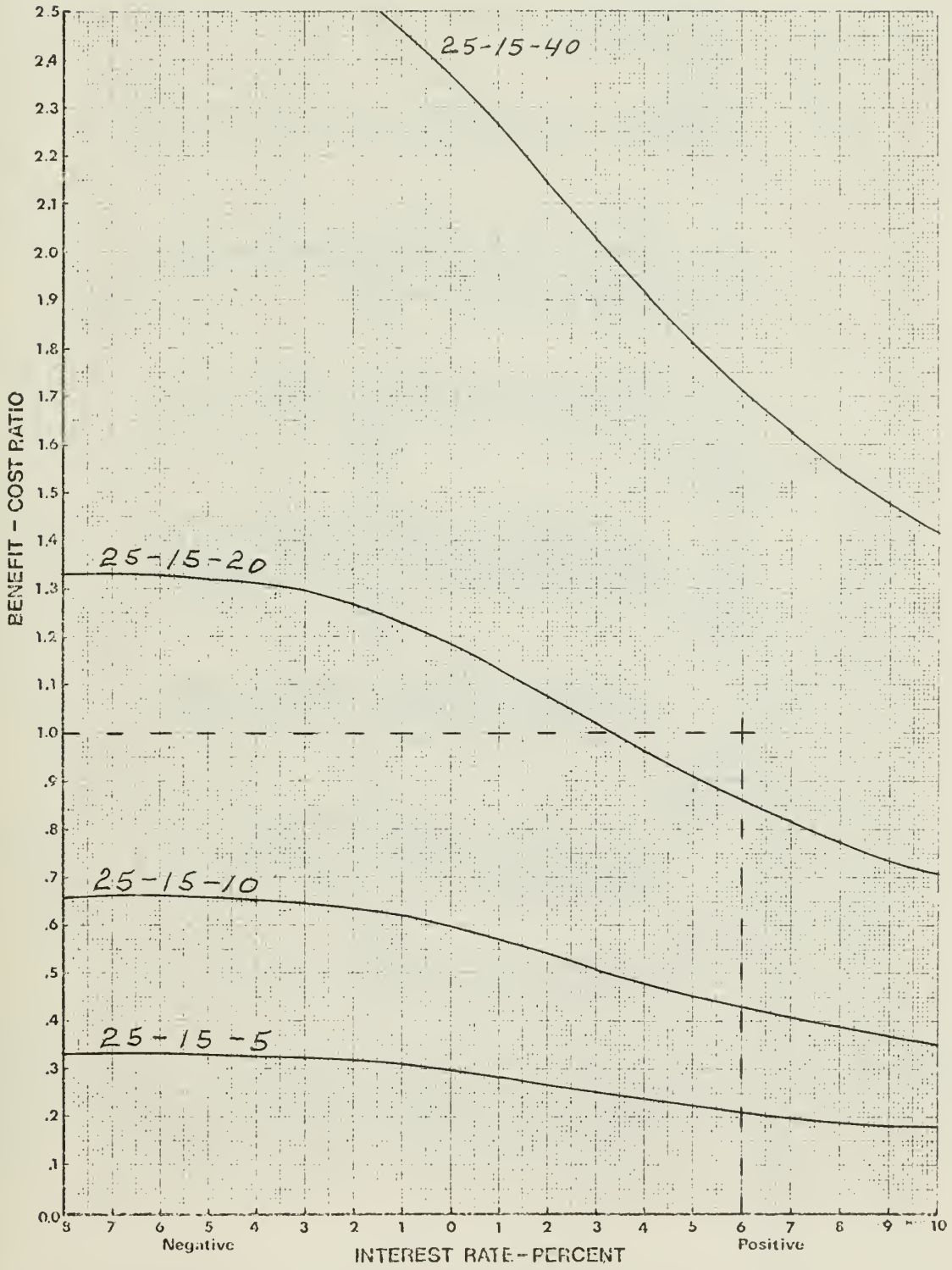
Code $25	Cost of PCT one acre			
$15	Cost to sell one MBF of mature timber			
$20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.86
Present net worth		@ 6%	=	-$9.95

Code $25	Cost to PCT one acre			
$15	Cost to sell one MBF of mature timber			
$40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.72
Present net worth		@ 6%	=	$50.42

Code $25	Cost of PCT one acre			
$15	Cost to sell one MBF of mature timber			
$80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	3.43
Present net worth		@ 6%	=	$171.17

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
25-15-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS. PROBLEM #2

PROBLEM NO. 2 L.P. PINE SITE INDEX 40 F.H. @ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	25 15 5		25 15 10		25 15 20		25 15 40		25 15 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-71276.33	0.33	-35856.59	0.66	35394.74	1.33	177495.53	2.66	461667.13	5.33
-9.00	-33085.08	0.33	-16650.59	0.66	16409.49	1.33	82338.55	2.66	214196.66	5.33
-8.00	-15048.53	0.33	-7907.06	0.66	7766.47	1.33	39022.93	2.66	101535.86	5.32
-7.00	-7036.77	0.33	-3852.88	0.66	3758.89	1.33	18938.43	2.66	49297.52	5.32
-6.00	-3324.33	0.33	-1935.65	0.66	1863.69	1.33	9440.39	2.65	24593.80	5.30
-5.00	-1932.40	0.33	-1009.36	0.66	948.04	1.32	4851.52	2.64	12658.48	5.28
-4.00	-1071.30	0.33	-551.18	0.65	495.13	1.31	2591.69	2.62	6754.81	5.24
-3.00	-638.74	0.32	-318.56	0.65	265.18	1.30	1429.28	2.59	3757.47	5.18
-2.00	-366.96	0.32	-190.97	0.63	144.99	1.27	826.94	2.54	2190.84	5.08
-1.00	-230.44	0.31	-131.33	0.62	80.11	1.23	561.76	2.47	1345.06	4.94
0.00	-155.40	0.30	-94.60	0.59	43.80	1.19	319.80	2.38	871.80	4.75
1.00	-120.91	0.28	-73.23	0.57	22.68	1.13	213.93	2.27	596.45	4.54
2.00	-95.13	0.27	-60.27	0.54	9.86	1.08	149.72	2.15	429.45	4.30
3.00	-78.81	0.25	-52.06	0.51	1.75	1.02	109.07	2.03	323.71	4.07
4.00	-69.03	0.24	-48.64	0.48	-3.61	0.96	82.20	1.93	253.83	3.84
5.00	-56.60	0.23	-42.90	0.45	-7.30	0.91	63.68	1.81	205.66	3.63
6.00	-55.27	0.21	-40.22	0.43	-9.95	0.86	50.42	1.72	171.17	3.43
7.00	-51.33	0.20	-38.24	0.41	-11.91	0.82	40.59	1.63	145.59	3.26
8.00	-48.31	0.19	-36.72	0.39	-13.41	0.78	33.06	1.55	126.01	3.10
9.00	-46.93	0.18	-35.53	0.37	-14.60	0.74	27.15	1.48	110.63	2.96
10.00	-44.62	0.18	-34.57	0.35	-15.54	0.71	22.39	1.42	98.25	2.84
11.00	-42.45	0.17	-33.73	0.34	-16.32	0.69	18.48	1.35	88.09	2.72
12.00	-41.14	0.16	-33.12	0.33	-16.97	0.65	15.22	1.31	79.61	2.62
13.00	-40.04	0.16	-32.56	0.31	-17.53	0.63	12.46	1.26	72.44	2.52
14.00	-39.09	0.15	-32.08	0.30	-18.00	0.61	10.09	1.22	66.29	2.44
15.00	-38.26	0.15	-31.67	0.29	-18.41	0.59	8.04	1.18	60.94	2.36

B-1

Present Net Worth

Benefit/Cost Ratio

50-05-(5-10-20-40-80)

Lodgepole Pine--Site Index 40

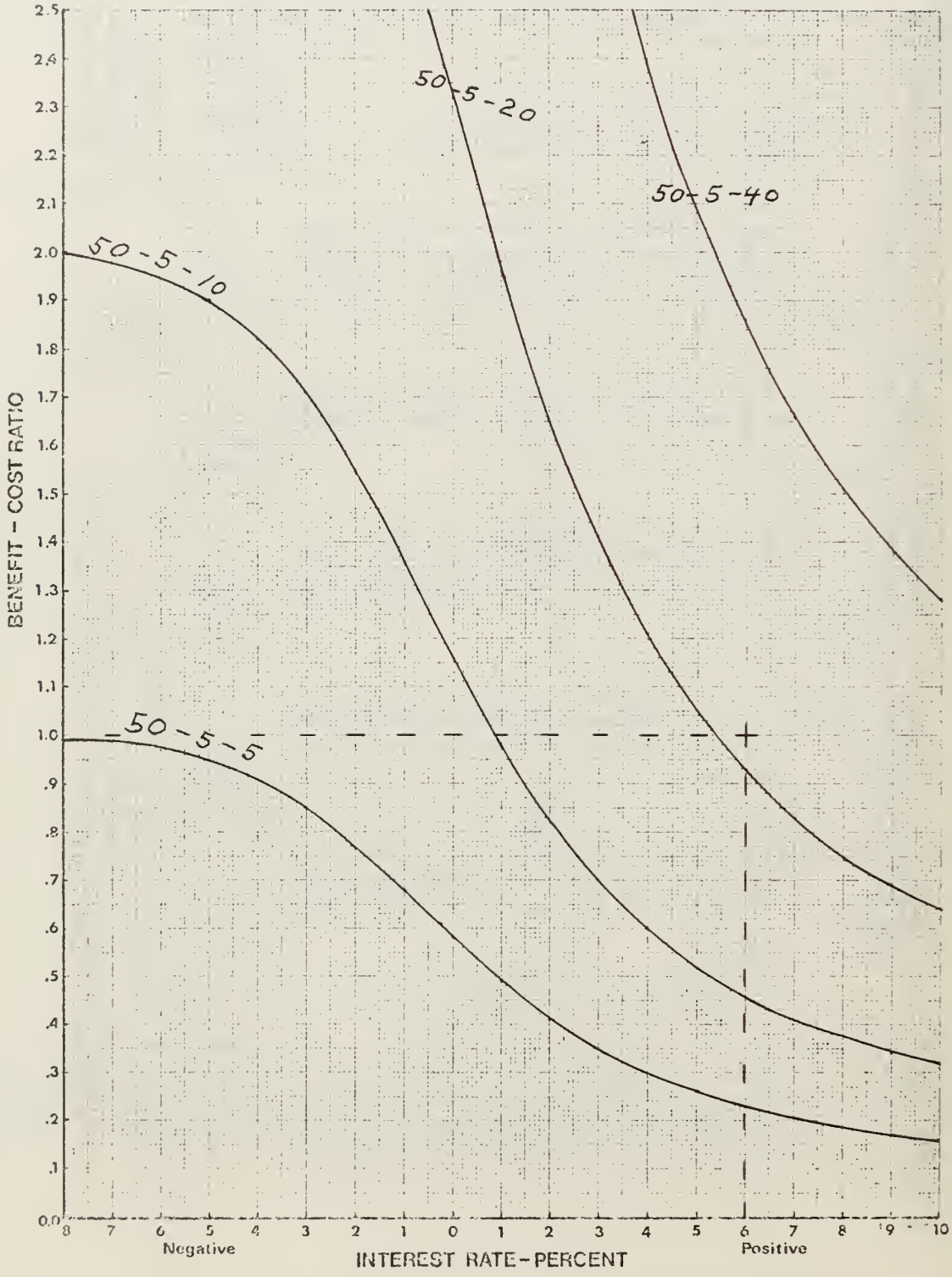
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code	$50	Cost to PCT one acre		
	$ 5	Cost to sell one MBF of mature timber		
	$ 5	Income from sale of one MBF of mature timber		
	B/C	Ratio	@ 6%	= 0.23
	Present net worth		@ 6%	= -$50.00
Code	$50	Cost to PCT one acre		
	$ 5	Cost to sell one MBF of mature timber		
	$20	Income from sale of one MBF of mature timber		
	B/C	Ratio	@ 6%	= 0.46
	Present net worth		@ 6%	= -$34.95
Code	$50	Cost of PCT one acre		
	$ 5	Cost to sell one MBF of mature timber		
	$20	Income from sale of one MBF of mature timber		
	B/C	Ratio	@ 6%	= 0.93
	Present net worth		@ 6%	= -$ 4.68
Code	$50	Cost to PCT one acre		
	$ 5	Cost to sell one MBF of mature timber		
	$40	Income from sale of one MBF of mature timber		
	B/C	Ratio	@ 6%	= 1.86
	Present net worth		@ 6%	= $55.70
Code	$50	Cost of PCT one acre		
	$ 5	Cost to sell one MBF of mature timber		
	$80	Income from sale of one MBF of mature timber		
	B/C	Ratio	@ 6%	= 3.71
	Present net worth		@ 6%	= $176.45

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
50- 5-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS-COSTS & RETURNS PROBLEM # 1

PROBLEM NO. 1 LODGEPOLE PINE-SITE INDEX 40 F.H. @ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

MANAGEMENT ALTERNATIVE

	50 05 05		50 05 10		50 05 20		50 05 40		50 05 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-50.00	1.00	35369.74	2.00	106621.06	4.01	248711.86	8.01	532893.46	16.09
-9.00	-50.00	1.00	16384.49	1.99	49444.57	4.00	115373.62	8.00	247231.74	16.00
-8.00	-50.00	0.99	7741.47	1.99	23415.00	3.99	54671.46	7.97	117184.39	15.94
-7.00	-50.00	0.99	3733.89	1.97	11345.65	3.96	26525.20	7.92	56884.29	15.84
-6.00	-50.00	0.97	1838.69	1.95	5638.02	3.91	13214.72	7.82	28368.13	15.63
-5.00	-50.00	0.95	923.04	1.90	2880.44	3.82	6783.92	7.63	14590.87	15.26
-4.00	-50.00	0.91	470.13	1.82	1516.43	3.66	3662.99	7.32	7776.11	14.64
-3.00	-50.00	0.85	240.18	1.71	823.92	3.42	1988.01	6.84	4316.21	13.69
-2.00	-50.00	0.77	119.99	1.55	461.95	3.10	1143.91	6.20	2507.80	12.40
-1.00	-50.00	0.68	55.11	1.36	266.54	2.72	688.19	5.44	1531.50	10.87
0.00	-50.00	0.58	18.80	1.16	157.20	2.32	433.20	4.65	985.20	9.29
1.00	-50.00	0.49	-2.32	0.98	93.53	1.96	284.84	3.92	667.36	7.83
2.00	-50.00	0.41	-15.14	0.82	55.00	1.65	194.86	3.30	474.58	6.59
3.00	-50.00	0.35	-23.25	0.70	30.57	1.40	137.88	2.80	352.52	5.59
4.00	-50.00	0.30	-28.61	0.60	14.42	1.20	100.23	2.40	271.84	4.81
5.00	-50.00	0.26	-32.30	0.52	3.29	1.05	74.28	2.10	216.26	4.19
6.00	-50.00	0.23	-34.95	0.46	-4.68	0.93	55.70	1.86	176.45	3.71
7.00	-50.00	0.21	-36.91	0.41	-10.59	0.83	41.91	1.66	146.92	3.33
8.00	-50.00	0.19	-38.41	0.38	-15.11	0.75	31.37	1.51	124.32	3.02
9.00	-50.00	0.17	-39.60	0.34	-18.66	0.69	23.08	1.38	106.56	2.76
10.00	-50.00	0.16	-40.54	0.32	-21.52	0.64	16.41	1.28	92.27	2.55
11.00	-50.00	0.15	-41.32	0.30	-23.87	0.59	10.93	1.19	80.55	2.37
12.00	-50.00	0.14	-41.97	0.28	-25.83	0.55	6.37	1.11	70.76	2.22
13.00	-50.00	0.13	-42.53	0.26	-27.49	0.52	2.50	1.04	62.47	2.09
14.00	-50.00	0.12	-43.00	0.25	-28.91	0.49	-0.82	0.99	55.37	1.97
15.00	-50.00	0.12	-43.41	0.23	-30.14	0.47	-3.69	0.93	49.21	1.87

B-2

Present Net Worth
Benefit/Cost Ratio
50-10-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $50	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.19
Present net worth		@ 6%	=	-$65.05

Code $50	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.38
Present net worth		@ 6%	=	-$50.00

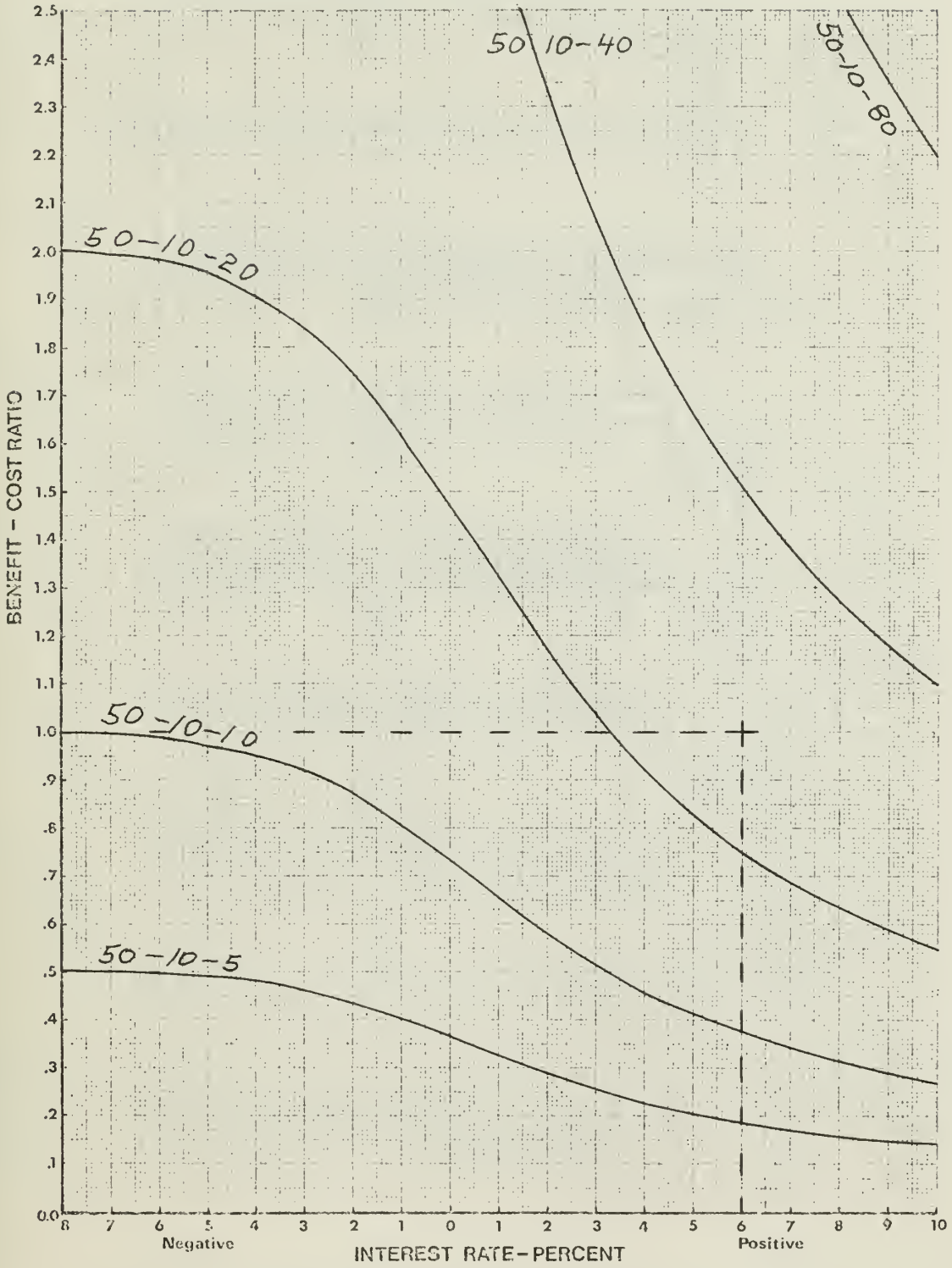
Code $50	Cost of PCT one acre			
$10	Cost to sell one MBF of mature timber			
$20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.75
Present net worth		@ 6%	=	-$19.73

Code $50	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.51
Present net worth		@ 6%	=	$40.65

Code $50	Cost of PCT one acre			
$10	Cost to sell one MBF of mature timber			
$80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	3.01
Present net worth		@ 6%	=	$161.40

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
50-10-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS. PROBLEM #2

PROBLEM NO. 2 L.P. PINE SITE INDEX 40 F.H. @ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	50 10 05		50 10 10		50 10 20		50 10 40		50 10 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-35469.74	0.50	-50.00	1.00	71291.33	2.00	213292.13	4.01	497473.73	8.02
-9.00	-15484.49	0.50	-50.00	1.00	33010.08	2.00	98939.14	4.01	230797.25	8.01
-8.00	-7341.47	0.50	-50.00	1.00	15623.53	2.00	46879.99	4.00	109392.92	8.00
-7.00	-3333.89	0.50	-50.00	0.99	7561.77	1.99	22741.31	3.99	53100.40	7.97
-6.00	-1938.69	0.49	-50.00	0.99	3749.33	1.98	11326.04	3.96	26479.44	7.92
-5.00	-1023.04	0.49	-50.00	0.97	1907.40	1.96	5810.88	3.91	13617.83	7.82
-4.00	-570.13	0.48	-50.00	0.95	936.30	1.91	3032.86	3.83	7255.99	7.66
-3.00	-340.18	0.46	-50.00	0.92	533.74	1.85	1697.83	3.69	4026.03	7.39
-2.00	-219.99	0.44	-50.00	0.87	291.96	1.75	973.91	3.51	2337.81	6.99
-1.00	-155.11	0.40	-50.00	0.81	151.44	1.62	583.09	3.24	1426.39	6.48
0.00	-113.80	0.37	-50.00	0.73	88.40	1.47	364.40	2.94	916.40	5.88
1.00	-87.63	0.33	-50.00	0.66	45.91	1.32	237.16	2.63	619.68	5.26
2.00	-84.86	0.29	-50.00	0.58	20.13	1.17	159.99	2.34	439.72	4.67
3.00	-76.75	0.26	-50.00	0.52	3.81	1.04	111.13	2.07	325.77	4.15
4.00	-71.39	0.23	-50.00	0.46	-6.97	0.92	78.84	1.85	250.45	3.70
5.00	-67.70	0.21	-50.00	0.41	-14.40	0.83	56.59	1.66	198.56	3.33
6.00	-65.05	0.19	-50.00	0.38	-19.73	0.75	40.65	1.51	161.40	3.01
7.00	-63.09	0.17	-50.00	0.34	-23.67	0.69	29.83	1.39	133.83	2.76
8.00	-61.59	0.16	-50.00	0.32	-26.69	0.64	19.78	1.27	112.73	2.54
9.00	-60.40	0.15	-50.00	0.29	-29.07	0.59	12.67	1.18	96.15	2.36
10.00	-59.46	0.14	-50.00	0.27	-30.98	0.55	6.95	1.10	82.82	2.20
11.00	-58.68	0.13	-50.00	0.26	-32.55	0.52	2.26	1.03	71.87	2.07
12.00	-58.03	0.12	-50.00	0.24	-33.86	0.49	-1.66	0.97	62.73	1.95
13.00	-57.47	0.12	-50.00	0.23	-34.96	0.46	-4.98	0.92	55.00	1.85
14.00	-57.00	0.11	-50.00	0.22	-35.91	0.44	-7.82	0.88	48.36	1.76
15.00	-56.59	0.10	-50.00	0.21	-36.74	0.42	-10.29	0.84	42.61	1.67

Present Net Worth
Benefit/Cost Ratio
50-15-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code	$50	Cost to PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$ 5	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	0.16
	Present net worth	@ 6%	=	-$80.27

Code	$50	Cost to PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$10	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	0.32
	Present net worth	@ 6%	=	-$65.22

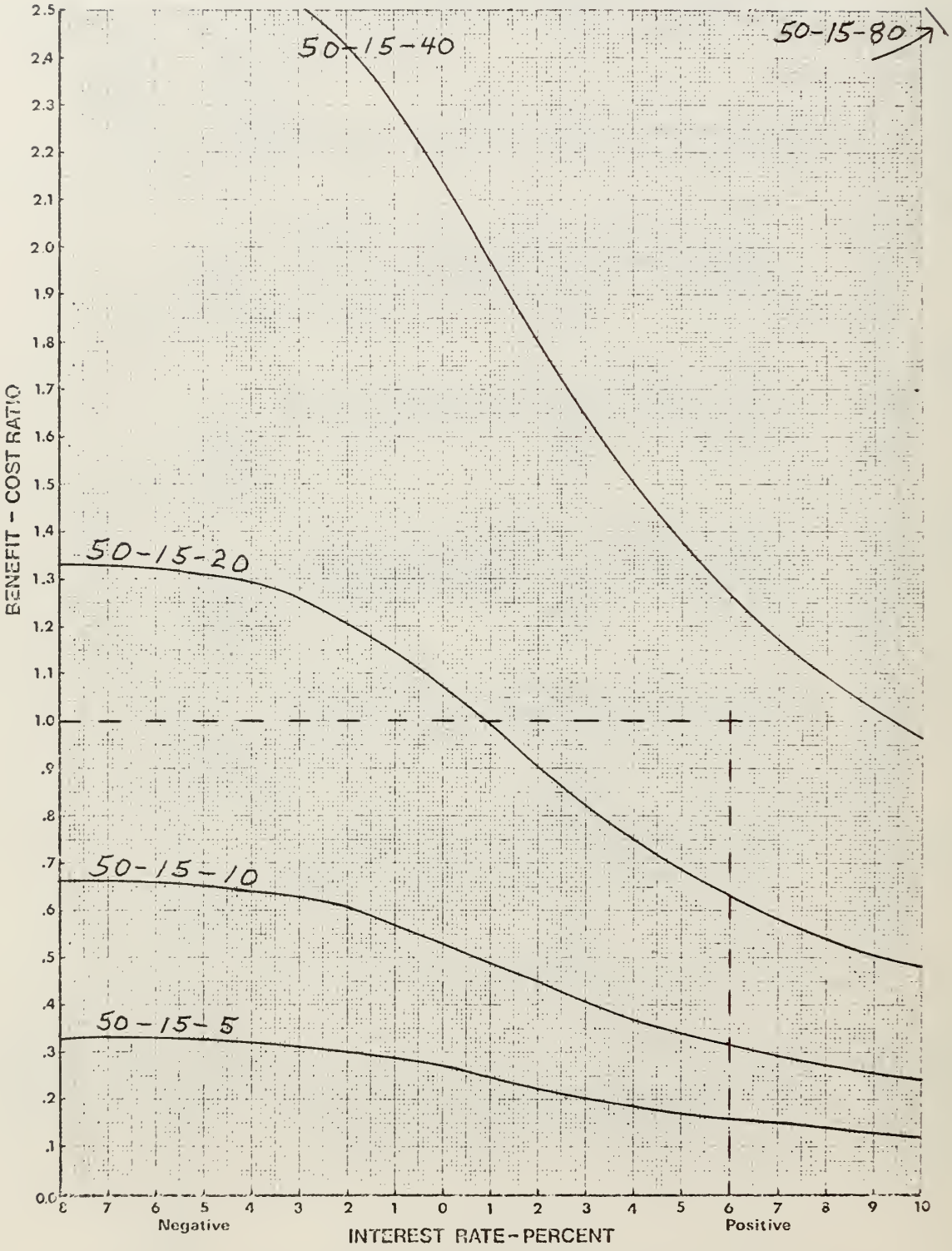
Code	$50	Cost of PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$20	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	0.63
	Present net worth	@ 6%	=	-$34.95

Code	$50	Cost to PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$40	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	1.27
	Present net worth	@ 6%	=	$25.42

Code	$50	Cost of PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$80	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	2.53
	Present net worth	@ 6%	=	$146.17

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
50-15-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS. PROBLEM #2

PROBLEM NO. 2 L.P. PINE SITE INDEX 40 F.H. @ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	50 15 5		50 15 10		50 15 20		50 15 40		50 15 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-71301.33	0.33	-35881.59	0.66	35349.74	1.33	177460.53	2.66	461642.13	5.33
-9.00	-33110.08	0.33	-16675.59	0.66	16384.49	1.33	82313.55	2.66	214171.66	5.32
-8.00	-15723.53	0.33	-7932.06	0.66	7741.47	1.33	38997.93	2.66	101510.86	5.32
-7.00	-7661.77	0.33	-3877.38	0.66	3733.89	1.33	18913.43	2.65	49272.52	5.30
-6.00	-3849.33	0.33	-1960.65	0.66	1838.69	1.32	9415.39	2.64	24568.80	5.28
-5.00	-2007.40	0.33	-1034.36	0.65	923.04	1.31	4826.52	2.62	12633.48	5.24
-4.00	-1096.30	0.32	-576.18	0.64	470.13	1.29	2556.69	2.58	6729.81	5.16
-3.00	-633.74	0.31	-343.56	0.63	240.18	1.26	1404.28	2.52	3732.47	5.04
-2.00	-391.96	0.30	-221.97	0.61	119.99	1.21	831.94	2.43	2165.84	4.85
-1.00	-261.44	0.29	-156.33	0.57	55.11	1.15	476.76	2.30	1320.06	4.60
0.00	-198.80	0.27	-119.60	0.53	18.80	1.07	294.80	2.15	846.80	4.29
1.00	-145.91	0.25	-98.23	0.49	-2.32	0.99	198.93	1.99	571.45	3.95
2.00	-120.13	0.22	-85.27	0.45	-15.14	0.90	134.72	1.80	404.45	3.61
3.00	-103.81	0.20	-77.06	0.41	-23.25	0.82	94.07	1.64	298.71	3.29
4.00	-93.03	0.19	-71.64	0.37	-28.61	0.75	67.20	1.51	228.82	3.00
5.00	-85.60	0.17	-67.90	0.34	-32.30	0.69	48.68	1.37	180.66	2.75
6.00	-80.27	0.16	-65.22	0.32	-34.95	0.63	35.42	1.27	146.17	2.53
7.00	-76.33	0.15	-63.24	0.29	-36.91	0.59	25.59	1.17	120.59	2.35
8.00	-73.31	0.14	-61.72	0.27	-38.41	0.55	18.06	1.09	101.01	2.19
9.00	-70.93	0.13	-60.53	0.26	-39.60	0.51	12.15	1.03	85.63	2.05
10.00	-69.02	0.12	-59.57	0.24	-40.54	0.48	7.61	0.97	73.25	1.93
11.00	-67.45	0.11	-58.78	0.23	-41.32	0.46	3.52	0.91	63.09	1.83
12.00	-66.14	0.11	-58.12	0.22	-41.97	0.43	-0.78	0.87	54.61	1.74
13.00	-65.04	0.10	-57.56	0.21	-42.53	0.41	-3.54	0.83	47.44	1.65
14.00	-64.09	0.10	-57.08	0.20	-43.00	0.40	-14.91	0.79	41.28	1.58
15.00	-63.26	0.09	-56.67	0.19	-43.41	0.38	-16.96	0.76	35.94	1.51

C-1

Present Net Worth
Benefit/Cost Ratio
75-05-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $75	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.17
Present net worth		@ 6%	=	-$75.00

Code $75	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.33
Present net worth		@ 6%	=	-$59.95

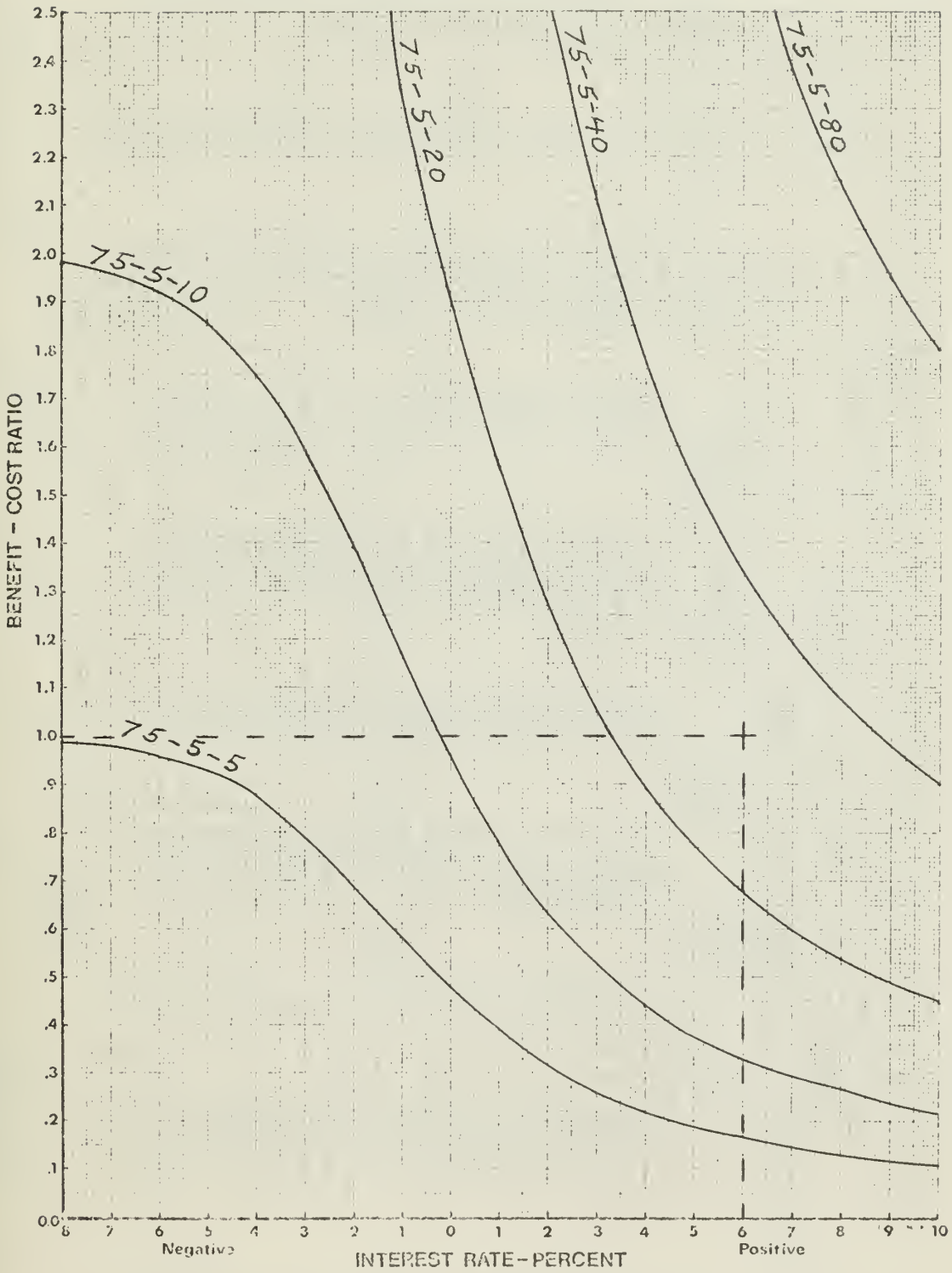
Code $75	Cost of PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.67
Present net worth		@ 6%	=	-$29.68

Code $75	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.34
Present net worth		@ 6%	=	$30.70

Code $75	Cost of PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	2.68
Present net worth		@ 6%	=	$151.45

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
75-05-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS-COSTS & RETURNS PROBLEM # 1

PROBLEM NO. 1 LODGEPOLE PINE-SITE INDEX 40 F.H. @ 100 YORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	75 05 05		75 05 10		75 05 20		75 05 40		75 05 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-75.00	1.00	35364.74	2.00	104595.05	4.00	248686.86	8.01	532868.46	16.01
-9.00	-75.00	1.00	16359.49	1.99	49419.57	3.99	115348.62	7.99	247206.74	15.97
-8.00	-75.00	0.99	7715.47	1.98	23390.00	3.97	54646.46	7.95	117159.39	15.89
-7.00	-75.00	0.98	3708.89	1.96	11320.65	3.93	26500.20	7.87	56859.29	15.73
-6.00	-75.00	0.96	1813.69	1.92	5613.02	3.86	13189.72	7.72	28343.13	15.43
-5.00	-75.00	0.93	895.04	1.86	2855.44	3.72	6758.92	7.45	14565.87	14.90
-4.00	-75.00	0.87	445.13	1.75	1491.43	3.51	3577.99	7.01	7751.11	14.02
-3.00	-75.00	0.79	215.18	1.59	798.92	3.19	1963.01	6.38	4291.21	12.75
-2.00	-75.00	0.69	94.99	1.39	436.96	2.78	1118.91	5.57	2482.80	11.13
-1.00	-75.00	0.58	30.11	1.17	241.54	2.34	663.19	4.68	1506.50	9.36
0.00	-75.00	0.48	-5.20	0.96	132.20	1.92	408.20	3.84	960.20	7.68
1.00	-75.00	0.39	-27.32	0.78	68.58	1.56	259.84	3.12	642.36	6.24
2.00	-75.00	0.32	-40.14	0.63	30.00	1.27	169.86	2.55	449.58	5.09
3.00	-75.00	0.26	-48.25	0.53	5.57	1.05	112.88	2.11	327.52	4.22
4.00	-75.00	0.22	-53.61	0.44	-10.58	0.89	75.23	1.78	246.84	3.56
5.00	-75.00	0.19	-57.30	0.38	-21.71	0.77	49.28	1.53	191.26	3.06
6.00	-75.00	0.17	-59.95	0.33	-29.69	0.67	30.70	1.34	151.45	2.68
7.00	-75.00	0.15	-61.91	0.30	-35.59	0.60	16.91	1.19	121.92	2.38
8.00	-75.00	0.13	-63.41	0.27	-40.11	0.54	6.37	1.07	99.32	2.15
9.00	-75.00	0.12	-64.60	0.24	-43.66	0.49	-1.92	0.98	81.56	1.95
10.00	-75.00	0.11	-65.54	0.22	-46.52	0.45	-8.59	0.90	67.27	1.80
11.00	-75.00	0.10	-66.32	0.21	-48.87	0.42	-14.07	0.83	55.55	1.66
12.00	-75.00	0.10	-66.97	0.19	-50.83	0.39	-18.63	0.78	45.76	1.55
13.00	-75.00	0.09	-67.53	0.18	-52.49	0.36	-22.50	0.73	37.47	1.45
14.00	-75.00	0.09	-68.00	0.17	-53.91	0.34	-25.82	0.69	30.37	1.37
15.00	-75.00	0.08	-68.41	0.16	-55.14	0.32	-28.69	0.65	24.21	1.30

C-2

Present Net Worth
Benefit/Cost Ratio
75-10-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0,01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $75	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	- 0.14
Present net worth		@ 6%	=	-$90.05

Code $75	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.29
Present net worth		@ 6%	=	-$75.00

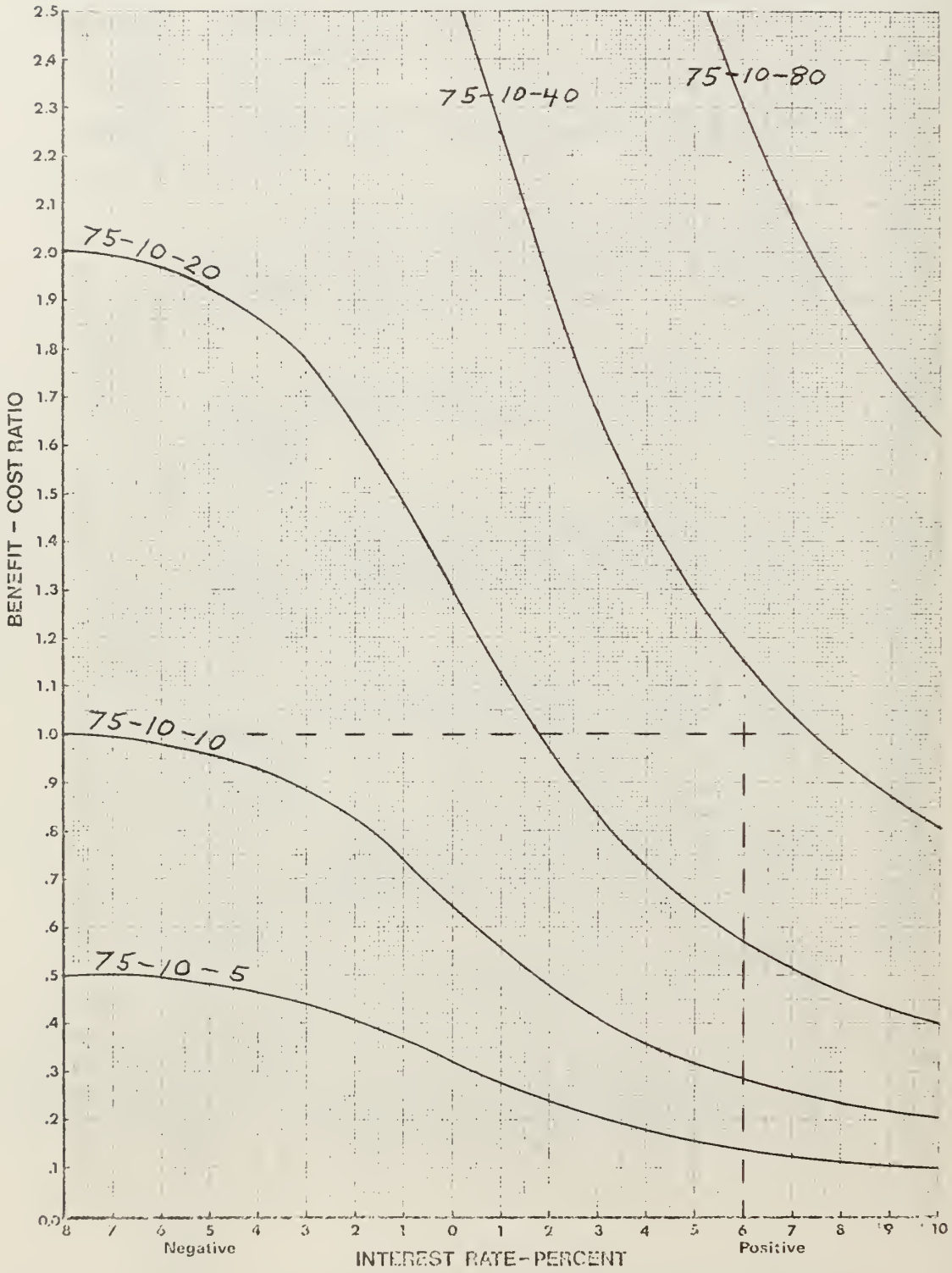
Code $75	Cost of PCT one acre			
$10	Cost to sell one MBF of mature timber			
$20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.57
Present net worth		@ 6%	=	-$44.73

Code $75	Cost to PCT one acre			
$10	Cost to sell one MBF of mature timber			
$40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.15
Present net worth		@ 6%	=	$15.65

Code $75	Cost of PCT one acre			
$10	Cost to sell one MBF of mature timber			
$80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	2.30
Present net worth		@ 6%	=	$136.40

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
75-10-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT ONLY @ 20 YEARS. PROBLEM #2

PROBLEM NO. 2 L.P. PINE SITE INDEX 40 F.H. @ 100 HTRAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	75 10 5		75 10 10		75 10 20		75 10 40		75 10 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-35494.74	0.50	-75.00	1.00	71176.33	2.00	213267.13	4.01	497448.73	8.01
-9.00	-16509.49	0.50	-75.00	1.00	32935.08	2.00	98914.14	4.00	230772.25	8.00
-8.00	-7366.47	0.50	-75.00	1.00	15598.53	2.00	46854.99	3.99	109367.92	7.98
-7.00	-3458.89	0.50	-75.00	0.99	7536.77	1.99	22716.31	3.97	53075.40	7.94
-6.00	-1963.69	0.49	-75.00	0.98	3724.33	1.97	11301.04	3.93	26454.44	7.87
-5.00	-1048.04	0.48	-75.00	0.96	1892.40	1.93	5785.88	3.86	13592.83	7.73
-4.00	-595.13	0.47	-75.00	0.93	971.30	1.87	3057.86	3.74	7230.99	7.48
-3.00	-365.18	0.44	-75.00	0.89	508.74	1.78	1672.83	3.55	4001.03	7.11
-2.00	-244.99	0.41	-75.00	0.82	266.96	1.64	948.91	3.29	2312.81	6.57
-1.00	-180.11	0.37	-75.00	0.74	136.44	1.48	558.09	2.96	1401.39	5.91
0.00	-143.80	0.32	-75.00	0.65	63.40	1.30	339.40	2.60	891.40	5.19
1.00	-122.68	0.28	-75.00	0.56	20.91	1.12	212.16	2.25	594.69	4.49
2.00	-109.86	0.24	-75.00	0.48	-4.87	0.97	134.99	1.93	414.72	3.87
3.00	-101.75	0.21	-75.00	0.42	-21.19	0.84	86.13	1.67	300.77	3.34
4.00	-96.39	0.18	-75.00	0.36	-31.97	0.73	53.84	1.46	225.45	2.91
5.00	-92.70	0.15	-75.00	0.32	-39.40	0.64	31.59	1.29	173.56	2.57
6.00	-90.05	0.14	-75.00	0.29	-44.73	0.57	15.65	1.15	136.40	2.30
7.00	-88.09	0.13	-75.00	0.26	-48.67	0.52	3.83	1.04	108.83	2.08
8.00	-86.59	0.12	-75.00	0.24	-51.69	0.47	-5.22	0.95	87.73	1.89
9.00	-85.40	0.11	-75.00	0.22	-54.07	0.44	-12.33	0.87	71.15	1.74
10.00	-84.46	0.10	-75.00	0.20	-55.98	0.40	-18.05	0.81	57.82	1.62
11.00	-83.68	0.09	-75.00	0.19	-57.55	0.38	-22.74	0.75	46.87	1.51
12.00	-83.03	0.09	-75.00	0.18	-58.86	0.35	-26.66	0.71	37.73	1.41
13.00	-82.47	0.08	-75.00	0.17	-59.96	0.33	-29.98	0.67	30.00	1.33
14.00	-82.00	0.08	-75.00	0.16	-60.91	0.32	-32.82	0.63	23.36	1.26
15.00	-81.59	0.07	-75.00	0.15	-61.74	0.30	-35.29	0.61	17.61	1.20

C-3

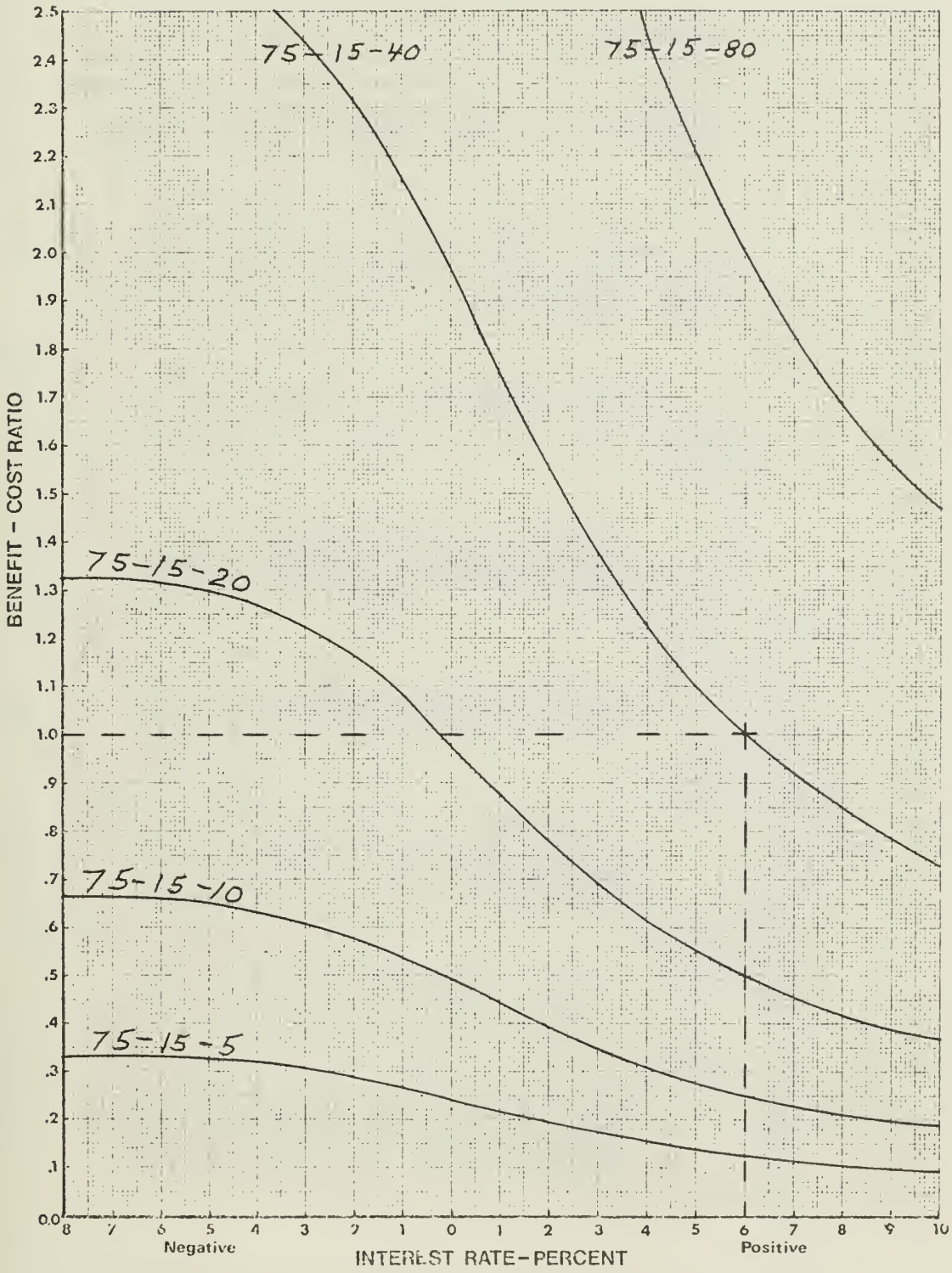
Present Net Worth
Benefit/Cost Ratio
75-15-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code	$75	Cost to PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$ 5	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	0.13
	Present net worth	@ 6%	=	-$105.27
Code	$75	Cost to PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$10	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	0.25
	Present net worth	@ 6%	=	-$90.22
Code	$75	Cost of PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$20	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	0.50
	Present net worth	@ 6%	=	-$59.95
Code	$75	Cost to PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$40	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	1.00
	Present net worth	@ 6%	=	$00.42
Code	$75	Cost of PCT one acre		
	$15	Cost to sell one MBF of mature timber		
	$80	Income from sale of one MBF of mature timber		
	B/C	Ratio @ 6%	=	2.01
	Present net worth	@ 6%	=	$121.17

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
75-15-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT @ 20 ONLY PROBLEM # 3

PROBLEM NO. 3 SP PINE SITE INDEX 40 FH@ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

MANAGEMENT ALTERNATIVE

	75 15 5		75 15 10		75 15 20		75 15 40		75 15 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-71326.33	0.33	-35906.59	0.66	35344.74	1.33	177435.53	2.66	461617.13	5.32
-9.00	-33135.08	0.33	-16700.59	0.66	16359.49	1.33	82288.55	2.66	214146.66	5.32
-8.00	-15748.53	0.33	-7957.06	0.66	7716.47	1.33	38972.93	2.66	101485.86	5.31
-7.00	-7585.77	0.33	-3902.88	0.66	3708.89	1.32	18888.43	2.65	49247.52	5.29
-6.00	-3674.33	0.33	-1985.65	0.66	1813.69	1.31	9390.39	2.63	24543.80	5.26
-5.00	-2032.40	0.32	-1059.36	0.65	898.04	1.30	4861.52	2.60	12608.48	5.20
-4.00	-1121.30	0.32	-601.18	0.63	445.13	1.27	2531.69	2.54	6704.81	5.08
-3.00	-655.74	0.31	-369.56	0.61	215.18	1.23	1379.28	2.45	3707.47	4.91
-2.00	-415.95	0.29	-246.97	0.58	94.99	1.16	776.94	2.32	2140.84	4.65
-1.00	-295.44	0.27	-191.33	0.54	30.11	1.08	451.76	2.15	1295.06	4.31
0.00	-213.40	0.24	-144.60	0.49	-6.20	0.98	269.80	1.96	821.80	3.91
1.00	-170.91	0.22	-123.23	0.44	-27.32	0.87	163.93	1.75	546.45	3.50
2.00	-145.13	0.19	-110.27	0.39	-40.14	0.78	99.72	1.55	379.45	3.11
3.00	-125.81	0.17	-102.06	0.34	-48.25	0.69	59.07	1.38	273.71	2.76
4.00	-115.03	0.15	-95.64	0.31	-53.61	0.62	32.20	1.23	203.82	2.46
5.00	-110.60	0.14	-92.90	0.28	-57.30	0.55	13.68	1.11	155.66	2.21
6.00	-105.27	0.13	-90.22	0.25	-59.95	0.50	0.42	1.00	121.17	2.01
7.00	-101.33	0.11	-88.24	0.23	-61.91	0.46	-9.41	0.92	95.59	1.84
8.00	-98.31	0.11	-86.72	0.21	-63.41	0.42	-16.94	0.85	76.01	1.69
9.00	-95.93	0.10	-85.53	0.20	-64.60	0.39	-22.85	0.79	60.63	1.57
10.00	-94.02	0.09	-84.57	0.18	-65.54	0.37	-27.61	0.73	48.25	1.47
11.00	-92.45	0.09	-83.78	0.17	-66.32	0.34	-31.52	0.69	38.09	1.38
12.00	-91.14	0.08	-83.12	0.16	-66.97	0.32	-34.78	0.65	29.61	1.30
13.00	-90.04	0.08	-82.56	0.15	-67.53	0.31	-37.54	0.62	22.44	1.23
14.00	-89.09	0.07	-82.08	0.15	-68.00	0.29	-39.91	0.58	16.28	1.17
15.00	-88.26	0.07	-81.67	0.14	-68.41	0.28	-41.96	0.56	10.94	1.12

D-1

Present Net Worth
Benefit/Cost Ratio
100-05-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $100	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.13
Present net worth		@ 6%	=	-$100.00

Code $100	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.26
Present net worth		@ 6%	=	-$84.95

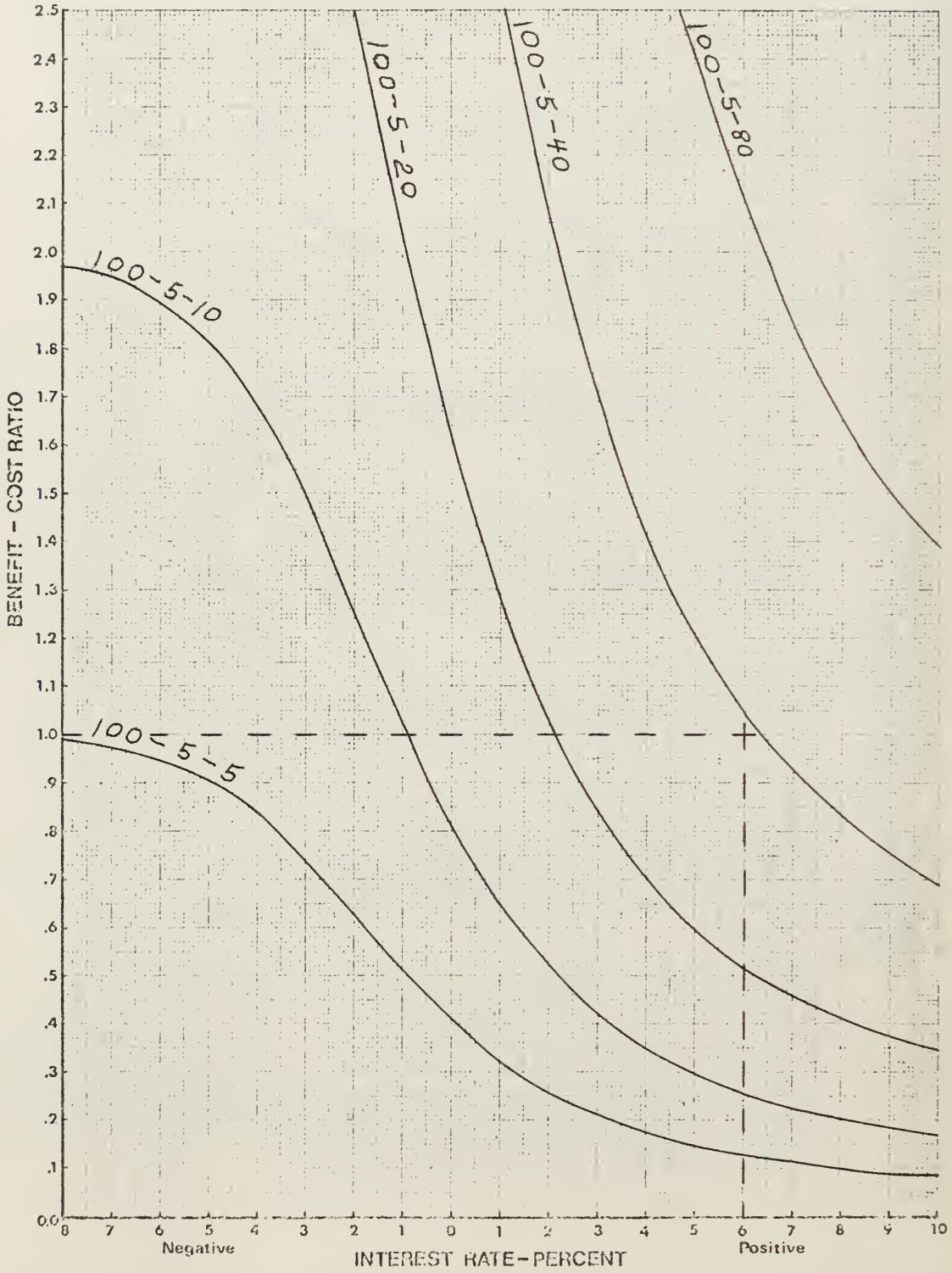
Code $100	Cost of PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.52
Present net worth		@ 6%	=	-$54.68

Code $100	Cost to PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.05
Present net worth		@ 6%	=	$5.70

Code $100	Cost of PCT one acre			
$ 5	Cost to sell one MBF of mature timber			
$ 80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	2.10
Present net worth		@ 6%	=	$126.45

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
100-05-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT @ 20 ONLY PROBLEM # 3

PROBLEM NO. 3 LP PINE SITE INDEX 40 FH@ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	100 5 5		100 5 10		100 5 20		100 5 40		100 5 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-100.00	1.00	35319.74	1.99	106571.06	4.00	248661.86	8.00	532843.46	16.00
-9.00	-100.00	0.99	16334.49	1.99	49394.57	3.99	115323.62	7.97	247181.74	15.95
-8.00	-100.00	0.99	7691.47	1.97	23365.00	3.96	54621.46	7.92	117134.39	15.84
-7.00	-100.00	0.97	3683.89	1.95	11295.66	3.91	26475.20	7.82	56834.29	15.63
-6.00	-100.00	0.95	1788.69	1.90	5588.02	3.81	13164.72	7.62	28318.13	15.24
-5.00	-100.00	0.91	873.04	1.81	2830.44	3.64	6733.92	7.28	14540.87	14.55
-4.00	-100.00	0.84	420.13	1.68	1466.43	3.36	3552.99	6.73	7726.11	13.46
-3.00	-100.00	0.74	199.18	1.49	773.92	2.98	1938.01	5.97	4266.21	11.93
-2.00	-100.00	0.63	89.99	1.26	411.96	2.53	1093.91	5.05	2457.80	10.10
-1.00	-100.00	0.51	5.11	1.02	216.54	2.06	638.19	4.11	1481.50	8.22
0.00	-100.00	0.41	-31.20	0.82	107.20	1.64	383.20	3.27	935.20	6.54
1.00	-100.00	0.32	-52.32	0.65	43.58	1.30	234.84	2.59	617.36	5.18
2.00	-100.00	0.26	-65.14	0.52	5.00	1.04	144.86	2.07	424.58	4.15
3.00	-100.00	0.21	-73.25	0.42	-19.43	0.85	87.88	1.69	302.52	3.39
4.00	-100.00	0.18	-78.61	0.35	-35.58	0.71	50.23	1.41	221.84	2.83
5.00	-100.00	0.15	-82.30	0.30	-46.71	0.60	24.28	1.21	166.26	2.41
6.00	-100.00	0.13	-84.95	0.26	-54.69	0.52	5.70	1.05	126.45	2.10
7.00	-100.00	0.12	-86.91	0.23	-60.59	0.46	-8.09	0.93	96.92	1.86
8.00	-100.00	0.10	-88.41	0.21	-65.11	0.42	-18.63	0.83	74.32	1.67
9.00	-100.00	0.09	-89.60	0.19	-68.66	0.38	-26.92	0.76	56.56	1.51
10.00	-100.00	0.09	-90.54	0.17	-71.52	0.35	-33.59	0.69	42.27	1.39
11.00	-100.00	0.08	-91.32	0.16	-73.87	0.32	-39.07	0.64	30.55	1.28
12.00	-100.00	0.07	-91.97	0.15	-75.83	0.30	-43.63	0.60	20.76	1.19
13.00	-100.00	0.07	-92.53	0.14	-77.49	0.28	-47.50	0.56	12.47	1.12
14.00	-100.00	0.07	-93.00	0.13	-78.91	0.26	-50.82	0.53	5.37	1.05
15.00	-100.00	0.06	-93.41	0.12	-80.14	0.25	-53.69	0.50	-0.79	0.99

Present Net Worth
Benefit/Cost Ratio
100-10-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $100	Cost to PCT one acre			
$ 10	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.12
Present net worth		@ 6%	=	-$115.05

Code $100	Cost to PCT one acre			
$ 10	Cost to sell one MBF of mature timber			
$ 10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.23
Present net worth		@ 6%	=	-$100.00

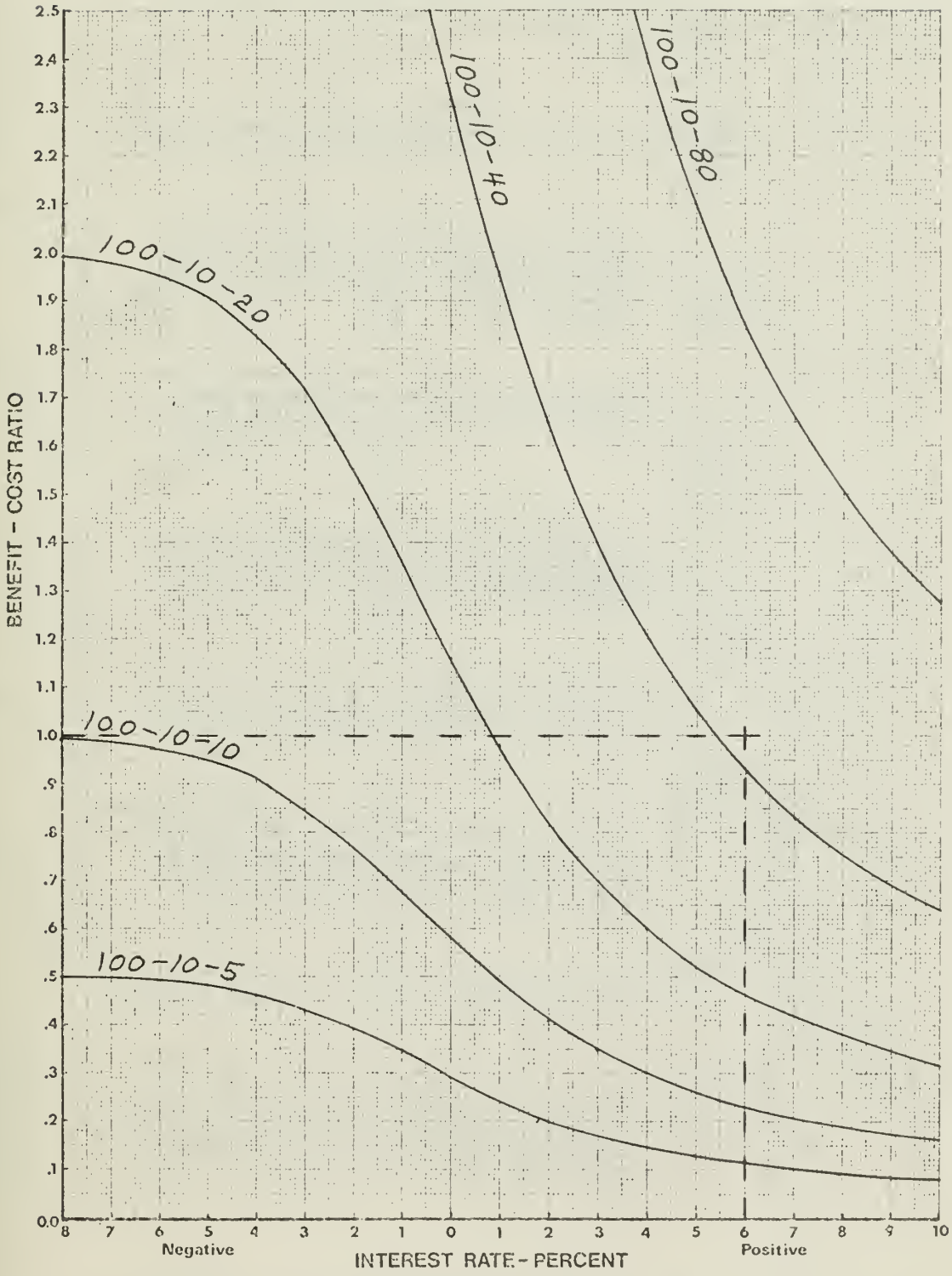
Code $100	Cost of PCT one acre			
$ 10	Cost to sell one MBF of mature timber			
$ 20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.46
Present net worth		@ 6%	=	-$69.73

Code $100	Cost to PCT one acre			
$ 10	Cost to sell one MBF of mature timber			
$ 40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.93
Present net worth		@ 6%	=	-$9.35

Code $100	Cost of PCT one acre			
$ 10	Cost to sell one MBF of mature timber			
$ 80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.86
Present net worth		@ 6%	=	$111.40

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
100-10-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT @ 20 ONLY PROBLEM # 3

PROBLEM NO. 3 LP PINE SITE INDEX 40 FH@ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

MANAGEMENT ALTERNATIVE

	10010 5		10010 10		10010 20		10010 40		10010 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-35519.74	0.50	-100.00	1.00	71151.33	2.00	213242.13	4.01	497423.73	8.01
-9.00	-16534.49	0.50	-100.00	1.00	32960.08	2.00	98889.14	4.00	230747.25	8.00
-8.00	-7891.47	0.50	-100.00	0.99	15573.53	1.99	46829.99	3.99	109342.92	7.97
-7.00	-3883.89	0.49	-100.00	0.99	7511.77	1.98	22691.31	3.96	53050.40	7.92
-6.00	-1985.69	0.49	-100.00	0.97	3699.33	1.95	11276.04	3.91	26429.44	7.82
-5.00	-1073.04	0.48	-100.00	0.95	1857.40	1.91	5760.88	3.82	13567.83	7.63
-4.00	-620.13	0.46	-100.00	0.91	946.30	1.83	3032.86	3.66	7205.99	7.32
-3.00	-390.18	0.43	-100.00	0.85	483.74	1.71	1647.83	3.42	3976.03	6.84
-2.00	-269.99	0.39	-100.00	0.77	241.96	1.55	953.91	3.10	2287.81	6.20
-1.00	-205.11	0.34	-100.00	0.68	111.44	1.36	533.09	2.72	1376.39	5.44
0.00	-165.80	0.29	-100.00	0.58	38.40	1.16	314.40	2.32	866.40	4.65
1.00	-147.68	0.24	-100.00	0.49	-4.09	0.98	187.16	1.96	569.68	3.92
2.00	-134.86	0.21	-100.00	0.41	-29.87	0.82	109.99	1.65	389.72	3.30
3.00	-126.75	0.17	-100.00	0.35	-46.19	0.70	61.13	1.40	275.77	2.80
4.00	-121.39	0.15	-100.00	0.30	-56.97	0.60	28.84	1.20	200.45	2.40
5.00	-117.70	0.13	-100.00	0.26	-64.40	0.52	6.59	1.05	148.56	2.10
6.00	-115.05	0.12	-100.00	0.23	-69.73	0.46	-9.35	0.93	111.40	1.86
7.00	-113.09	0.10	-100.00	0.21	-73.67	0.42	-21.17	0.83	83.83	1.66
8.00	-111.59	0.09	-100.00	0.19	-76.69	0.38	-30.22	0.75	62.73	1.51
9.00	-110.40	0.09	-100.00	0.17	-79.07	0.35	-37.33	0.69	46.15	1.38
10.00	-109.46	0.08	-100.00	0.16	-80.98	0.32	-43.05	0.64	32.82	1.28
11.00	-108.68	0.07	-100.00	0.15	-82.55	0.30	-47.74	0.59	21.87	1.19
12.00	-108.03	0.07	-100.00	0.14	-83.86	0.28	-51.66	0.55	12.73	1.11
13.00	-107.47	0.07	-100.00	0.13	-84.96	0.26	-54.98	0.52	5.00	1.04
14.00	-107.00	0.06	-100.00	0.12	-85.91	0.25	-57.82	0.49	-1.64	0.99
15.00	-106.59	0.06	-100.00	0.12	-86.74	0.23	-60.29	0.47	-7.39	0.93

Present Net Worth
Benefit/Cost Ratio
100-15-(5-10-20-40-80)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--At 20 Years of Age

Average stand volume-mature timber	10,000	Bd. Ft. acre
Increase in volume due to thinning	13,800	Bd. Ft. acre
Investment period	80	Years
Annual allowable cut increment increase	172.5	Bd. Ft.
Additional acreage cut and reforested 1/	0.01725	Acres
Cost of reforestation @$50.00 per acre 1/	$0.86	Annually

Code $100	Cost to PCT one acre			
$ 15	Cost to sell one MBF of mature timber			
$ 5	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.10
Present net worth		@ 6%	=	-$130.27

Code $100	Cost to PCT one acre			
$ 15	Cost to sell one MBF of mature timber			
$ 10	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.21
Present net worth		@ 6%	=	-$115.22

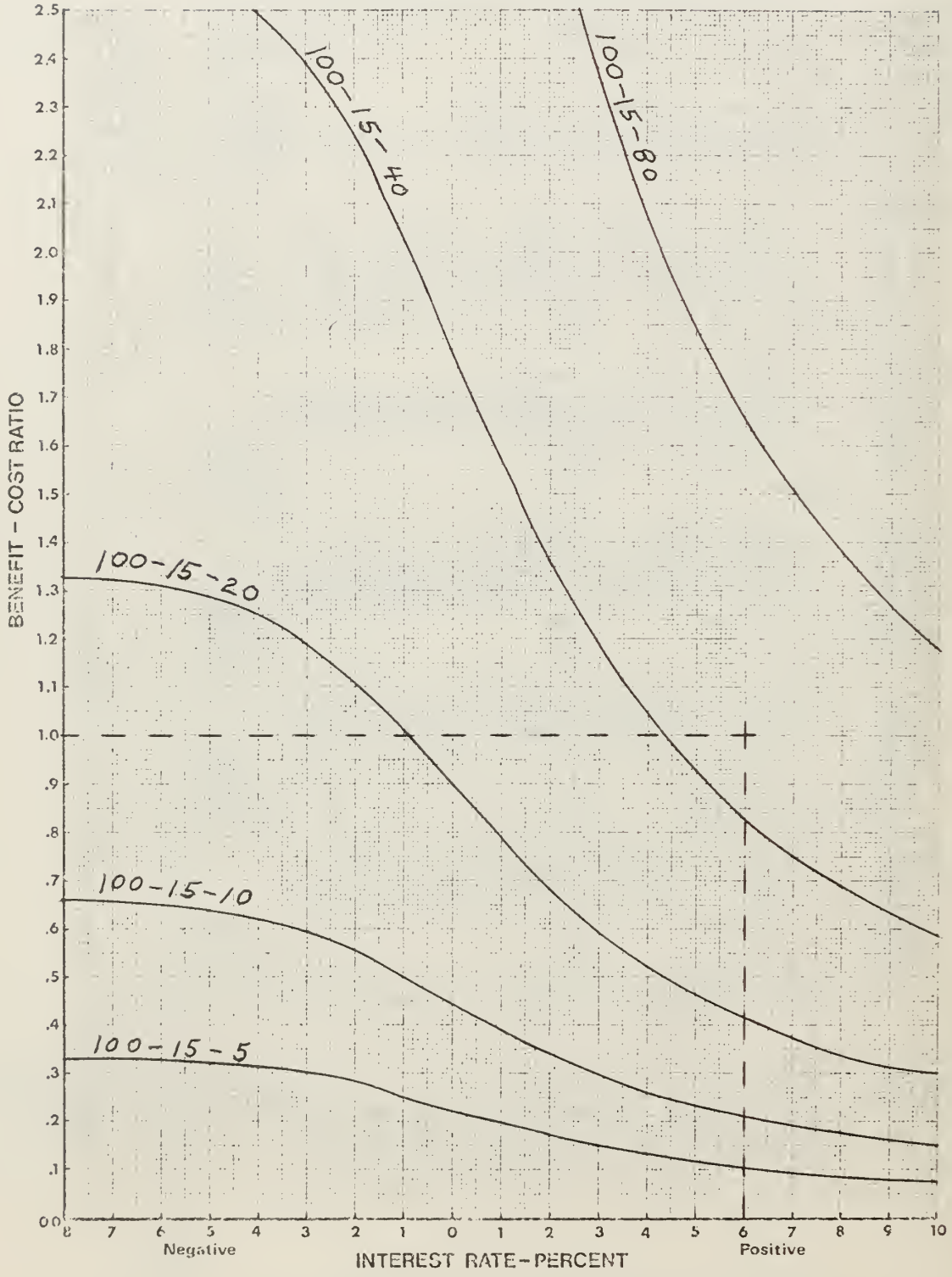
Code $100	Cost of PCT one acre			
$ 15	Cost to sell one MBF of mature timber			
$ 20	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.42
Present net worth		@ 6%	=	-$84.95

Code $100	Cost to PCT one acre			
$ 15	Cost to sell one MBF of mature timber			
$ 40	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	0.93
Present net worth		@ 6%	=	-$11.32

Code $100	Cost of PCT one acre			
$ 15	Cost to sell one MBF of mature timber			
$ 80	Income from sale of one MBF of mature timber			
B/C	Ratio	@ 6%	=	1.85
Present net worth		@ 6%	=	$130.66

1/ Site Index 40 Lodgepole pine is generally clear-cut and can be regenerated naturally; therefore, no reforestation costs were included in the above B/C analysis. If you wish to include reforestation costs of $50.00 per acre, note that this is equivalent to adding $5.00 per MBF to the cost of selling timber.

BENEFIT/COST RATIO
Alternatives
100-15-(5-10-20-40-80-)
Lodgepole Pine--Site Index 40
Precommercial Thin Only--@ 20 Years of Age



BENEFIT-COST ANALYSIS--PCT @ 20 ONLY PROBLEM # 3

PROBLEM NO. 3 SP PINE SITE INDEX 40 FH@ 100 HORAK

BENEFIT-COST RATIO (B/C) AT ALTERNATIVE RATES OF INTEREST
PRESENT NET WORTH (PNW) AT ALTERNATIVE RATES OF INTEREST

	MANAGEMENT ALTERNATIVE									
	10015 5		10015 10		10015 20		10015 40		10015 80	
RATE	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*	*PNW	B/C*
-10.00	-71351.33	0.33	-35931.59	0.66	35319.74	1.33	177410.53	2.66	461592.13	5.32
-9.00	-33160.08	0.33	-15725.59	0.66	16334.49	1.33	82263.55	2.66	214121.66	5.32
-8.00	-15773.53	0.33	-7482.06	0.66	7691.47	1.33	38947.93	2.65	101460.86	5.31
-7.00	-7711.77	0.33	-3927.88	0.66	3683.89	1.32	18863.43	2.64	49222.52	5.28
-6.00	-3899.33	0.33	-2010.65	0.65	1788.69	1.31	9365.39	2.62	24518.80	5.24
-5.00	-2057.40	0.32	-1084.36	0.64	873.04	1.29	4776.52	2.58	12583.48	5.15
-4.00	-1145.30	0.31	-625.18	0.62	420.13	1.25	2506.69	2.50	6679.81	5.01
-3.00	-683.74	0.30	-393.56	0.60	190.18	1.20	1354.28	2.39	3682.47	4.78
-2.00	-441.96	0.28	-271.97	0.56	69.99	1.11	751.94	2.23	2115.84	4.46
-1.00	-311.44	0.25	-205.33	0.50	5.11	1.01	426.76	2.02	1270.06	4.05
0.00	-238.40	0.22	-169.60	0.45	-31.20	0.90	244.80	1.80	796.80	3.59
1.00	-195.91	0.20	-148.23	0.39	-52.32	0.79	138.93	1.57	521.45	3.14
2.00	-170.13	0.17	-135.27	0.34	-65.14	0.68	74.72	1.36	354.45	2.73
3.00	-153.81	0.15	-127.06	0.30	-73.25	0.59	34.07	1.19	248.71	2.38
4.00	-143.03	0.13	-121.64	0.26	-78.61	0.52	7.20	1.04	178.82	2.09
5.00	-135.60	0.12	-117.90	0.23	-82.30	0.46	-11.32	0.93	130.66	1.85
6.00	-130.27	0.10	-115.22	0.21	-84.95	0.42	-24.58	0.83	96.17	1.66
7.00	-126.33	0.09	-113.24	0.19	-86.91	0.38	-34.41	0.75	70.59	1.51
8.00	-123.31	0.09	-111.72	0.17	-88.41	0.34	-41.94	0.69	51.01	1.38
9.00	-120.93	0.08	-110.53	0.16	-89.60	0.32	-47.85	0.64	35.63	1.27
10.00	-119.02	0.07	-109.57	0.15	-90.54	0.30	-52.61	0.59	23.25	1.18
11.00	-117.45	0.07	-108.78	0.14	-91.32	0.28	-56.52	0.55	13.09	1.10
12.00	-116.14	0.06	-108.12	0.13	-91.97	0.26	-59.78	0.52	4.61	1.04
13.00	-115.04	0.06	-107.56	0.12	-92.53	0.24	-62.54	0.49	-2.56	0.98
14.00	-114.09	0.06	-107.08	0.12	-93.00	0.23	-64.91	0.46	-8.72	0.93
15.00	-113.25	0.05	-106.67	0.11	-93.41	0.22	-66.96	0.44	-14.06	0.88

IX. Interpolation Procedure

The forester may follow the steps outlined below to interpolate between the data given in canned examples. Is it feasible to suggest a thinning under these conditions.

A. Field Test:
The following conditions are found in a field problem area:

- Average site quality is 42 (50 year base).
- Anticipated low bid for PCT = $65.00/acre.
- Administrative cost for selling old-growth timber averages $12.00/MBF.
- Average bid price for old-growth = $35.00
- Harvest old-growth using the shelterwood 2-stage overstory removal procedure.

1. Interpolate a $12.00 cost curve proportionately between the 50-10-40 and the 50-15-40 curves:

50-15-40 @ 6% interest rate	=	1.51 B/C ratio
50-10-40 @ 6% interest rate	=	1.27 B/C ratio
50-12-40 @ 6% interest rate	=	1.414 B/C ratio

2. Interpolate @ $12.00 cost curve proportionately bewteen the 75-10-40 and the 75-15-40 curves:

75-10-40 @ 6% interest rate	=	1.15 B/C ratio
75-15-40 @ 6% interest rate	=	1.00 B/C ratio
75-12-40 @ 6% interest rate	=	1.09 B/C ratio

3. Interpolate the $65.00/acre PCT cost between the 50-12-40 and the 75-12-40 points you have just developed:

50-12-40 @ 6% interest rate	=	1.414 B/C ratio
75-12-40 @ 6% interest rate	=	1.090 B/C ratio
65-12-40 @ 6% interest rate	=	1.2196 B/C ratio

4. Use the same method as in steps 1, 2, and 3 above except that $20.00 bid price for timber is used.
   a. See #1 above.

50-15-20 @ 6% interest rate	=	0.63 B/C ratio
50-10-20 @ 6% interest rate	=	0.75 B/C ratio
50-12-20 @ 6% interest rate	=	0.702 B/C ratio

b. See #2 above.

75-10-20 @ 6% interest rate	=	0.57	B/C ratio
75-15-20 @ 6% interest rate	=	0.50	B/C ratio
75-12-20 @ 6% interest rate	=	0.54.2	B/C ratio

c. See #3 above.

50-12-20 @ 6% interest rate	=	0.702	B/C ratio
75-12-20 @ 6% interest rate	=	0.542	B/C ratio

5. Interpolate the $35.00 price received for old growth timber.

65-12-40 @ 6% interest rate	=	1.2196	B/C ratio
65-12-20 @ 6% interest rate	=	0.6060	B/C ratio
65-12-35 @ 6% interest rate	=	1.0662	B/C ratio

This analysis shows that a favorable B/C ratio is produced from timber alone. Other multiple use benefits may add considerable more vitality to the proposal.

GPO 843 - 930

Borrower's

An economic analys
proposed timber
Report no.1.

Date Loaned	Borrower